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HYDROLYTIC STABILITY OF POTTING COMPOUNDS FOR ELECTRICAL CONNECTORS

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AIR FORCE MATERIALS LABORATORY

TECHNICAL REPORT AFML-TR-70-105

NOVEMBER 1970

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FOREWORD

This report was prepared by Materials Engineering Branch, Materials Support Division, Air Force Materials Laboratory under Project 7381, "Materials Applications," Task 738106, "Engineering and Design Data" with Philip A. House acting as project engineer.

The testing described herein was performed from August 1968 to April 1970, by the Dayton Laboratory of Monsanto Research Corporation under Contract F33615-69-C-1190.

It has been deemed advisable to code all these materials to protect the proprietary rights of the manufacturers. The manufacturers have been informed of the identity of their own products. A code sheet giving the identity of the materials has been published as Supplement 1 to this report. Supplement 1 is available only to U. S. Government personnel and is "For Official Use Only." Copies of Supplement 1 can be obtained from AFML (LAE), Wright-Patterson AFB, Ohio 45433.

This technical report has been reviewed and is approved.

Albert Olevitch

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ABSTRACT

This report describes an extensive evaluation of elastomeric potting compounds for their ability to withstand long term exposure to high temperature and humidities. This work was initiated as a result of the reversion of potting compounds in the electrical connectors on the F-4 in which the compounds softened and liquefied. Materials tested included polyurethanes, epoxies, silicones and polysulfides. Coatings and tubing were tested in addition to the potting compounds. This effort involved the establishment of more severe humidity-temperature tests than were previously used in military specifications. The results of testing many specification and non-specification compounds to the more severe conditions are included.

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SECTION I

INTRODUCTION

During mid-1968 the humidity resistance of electrical potting compounds became one of the most important materials problems faced by the Air Force. It was found that the potting compound used to encapsulate or pot connectors, relays, and switches on the F-4 aircraft was turning into a liquid and flowing. The material was dripping out of its shells and creating a gooey, sticky mess besides leaving electrical components unprotected.

Figure 1 shows a connector prior to potting; Figure 2 shows a connector after potting. The potting compound is usually a two-part flowable material which is poured into the potting mold (connector shell) and is then cured to an elastomer. Some materials cure at room temperature but heat cures such as 6 hours at 180°F are also used. The purpose of the potting compound is to seal out dirt and moisture, to provide support of the wires, and to protect against wire breakage during vibration. The material is also used for potting of relays and switches.

The material in question was a polyester polyurethane. This material is very susceptible to degradation by high humidity. Upon exposure to humidity the material starts to soften or revert, eventually becoming a liquid. Figures 3 and 4 shows switches potted with this material. In Figure 3, the potting compound, although soft, is still in place. The potting compound in Figure 4 has been easily deformed and is almost ready to liquefy. Figure 5 shows a relay where the polyester polyurethane has become liquid and flowed. The parts shown in Figures 3, 4, and 5 are approximately 10 years old and were never out of the warehouse. They were stored at Defense Electronics Supply Center, Dayton, Ohio. These are not isolated cases as many other parts in a similar condition were found on the warehouse shelves.

Figures 6, 7, and 8 show actual cases of reversion of potting compound in aircraft. Notice the way the potting compound has run all over various parts thus presenting a difficult clean-up problem. Also, notice in Figure 8, the difficult access to some of the affected parts.

The polyester polyurethane was used in the F-4 during the 1961-1965 time period. From 1965 to 1968, Polymer B was used. Polymer B is 3 to 4 times better than the polyester polyurethane that was used in resisting degradation by humidity but it also is subject to reversion

and has reverted in service. As yet, all cases of reversion of Polymer B has been caused by improperly mixed material but properly mixed Polymer B will revert under hot, humid conditions.

These reverting potting compounds created a necessity to evaluate all potting compounds for resistance to humidity. Particular attention had to be given to polyurethanes but the reversion of other materials such as polysulfides, silicones, and epoxies was also possible. A program was, therefore, initiated to evaluate all candidate potting materials.

SECTION II

SELECTION OF MATERIALS

A survey was taken of Air Force systems to identify the potting compounds being used. Many of these were materials conforming to military specifications but there were also many proprietary compounds. Special attention was paid to polyurethanes of the polyester type. There were really very few of this type material being used but all polyester materials that were judged to be suspicious were obtained. In addition samples of materials meeting MIL-S-8516, MIL-S-8802, MIL-I-16923, MIL-S-23586, MIL-M-24041, MIL-I-46058, Type PUR, MIL-I-81550 and MIL-S-81732 were obtained. Most materials were evaluated as potting compounds, but some such as the MIL-I-46058 materials were evaluated as coatings. Some polyurethane foams which were identified in the survey were also tested as was a polyester polyurethane tubing. The tubing did not turn liquid but did embrittle and break up badly.

SECTION III

TEST PROCEDURES

It was obvious that the humidity resistance tests in existing specifications which usually are never more than 14 days were not adequate.

A test procedure was devised that would be simple to perform and allow the evaluation of many materials. The test temperatures were 160°F and 200°F, at 100% Relative Humidity. These conditions were maintained by keeping a 1-inch layer of water on the bottom of a desiccator and placing the desiccator in an oven at the desired temperature. Control specimens were maintained at 77°F and 50% RH.

Rigid aluminum electrical conduit with an inside diameter of 1 3/8 inches was cut into 1-inch lengths. The potting compounds were poured into these shells and cured according to the manufacturer's recommendations. Primers were used on the aluminum shell when specified. (It should be noted that attempting to determine recommended cure conditions was in many cases almost impossible. Data sheets and labels on cans are sometimes in conflict. Many times recommended cure conditions could not be found. This is certainly an area that potting compound manufacturers can improve.) Usually, nine specimens were prepared for each compound. Three were used for hardness, three for compression load, and three for insulation resistance (one at each temperature 77°F, 160°F, and 200°F). After curing, insulation resistance specimens were prepared by inserting two screws spaced evenly from the cylinder walls and 3/4-inch from each other. Figure 9 shows samples that were prepared. The sample on the left was used for hardness or compression load testing and the one on the right for insulation resistance. Coating material specimens were prepared by dipcoating aluminum panels and foam specimens were foamed in plastic beakers.

Originally, three tests were conducted on the samples: hardness, compression load, and insulation resistance. In addition, the samples were examined for adhesion to the aluminum shell, tackiness, and general appearance. Initially, the samples were examined daily but this was later changed to weekly inspection. After a material had been subjected to humidity for 120 days the test was either stopped or continued dependent on the results. If continued the determinations were made monthly. Not all data points are reported in the tables in the appendix; only those where the material properties changed.

Hardness testing was conducted using a Rex Hardness Gauge, Type A for the elastomeric materials. A Shore tester could not be used because of an interference between the tester and

the aluminum shell. A Rex Hardness Gauge, Type B was used for the epoxy materials and the readings were converted to Rex A. This was not considered to be a good method because very little change was noted with the epoxies in hardness readings on the 160°F samples, whereas, the same material reverted at 200°F. Similar testing by another organization using a Shore D hardness tester showed changes in hardness upon 160°F exposure.

Compression resistance was measured by determining the load required to compress the material 10%. This test was discontinued because performance of the test was rather time consuming and the results were paralleled by the change in hardness. Also, the changes in specimen height due to swelling or contraction of the test specimen made it difficult to perform the test without error.

Insulation resistance tests were conducted in accordance with Method 302 of MIL-STD-202.

SECTION IV

TEST RESULTS

A. POLYURETHANES

An extensive number of polyurethane based materials were evaluated because a polyurethane material was reverting in the F-4 aircraft. A total of 27 such materials were evaluated. These were mainly potting compounds but there were also polyurethane coatings, foams, and tubing included. The military specifications involved were MIL-M-24041 for polyether polyurethane potting compounds and MIL-I-46058, Type PUR for polyurethane printed circuit coatings. Most of the other materials including the foams and the tubing were identified in the survey of Air Force Systems.

Compounds U-1 and U-2 were the only polyester polyurethane potting compounds identified. These materials were, by far, worse than any other potting compounds evaluated (Tables I and II). Note that in only 4 days at 200°F or 18 days at 160°F, Compound U-1 had fallen to O hardness. Figure 10 shows the condition of U-2 after 29 days at 160°F and 100% RH. Other have shown that U-1 will soften to a hardness of 20 in 190 days at 150°F with a humidity of 18%. A condition of 150°F and 18% could probably be obtained every day in closed compartments in aircraft in Southeast Asia. Compound U-1 would be expected to last 2 to 3 years in Southeast Asia. U-1 does not revert in anhydrous conditions at 203°F. Compound U-2 was used in one military application and the personnel responsible for that system have been informed.

The next 4 compounds U-3, U-4, U-5, and U-6 are all polyether polyurethanes which have relationship to MIL-M-24041. U-3 and U-4 are qualified and U-5 and U-6 are being considered for qualification. Test results are shown in Tables III, IV, V, and VI. There are differences in the performance of these 4 materials but all would meet the requirements set forth in USAF Interim Amendment 2 to MIL-M-24041. This amendment requires a maximum loss of 20% in hardness and a minimum insulation resistance of $1X10^9$ ohms after aging 120 days at 160°F and 100% R.H. Compound U-5 is certainly borderline in these tests and did fall below the minimum allowable insulation resistance during the test, although after 120 days the insulation resistance was exactly the minimum requirement. The cracking and loss of adhesion was not noted until the material was beyond the 120-day test period. Also, U-5 did not withstand the 200°F aging as well as the other MIL-M-24041 materials. Certainly, tests on U-5 would have to be repeated before qualifying because of the several borderline conditions.

The test condition of 160°F and 100% R.H. was selected rather than the 200°F and 100% R.H. condition for the Interim Amendment. At 200°F and 100% R.H. the rate of loss in hardness of all materials including those qualified to MIL-M-24041 was very high. With such a steep fall-off in hardness it was hardly possible to make a decision as to an allowable hardness loss. However, at 160°F and 100% R.H. the rate of hardness loss was quite low and a reasonable choice in hardness loss could be made.

The exposure period, 120 days at 160°F and 100% R.H. is almost 7 times as long as is required for U-1 to turn liquid and the polyether polyurethanes still had a very reasonable hardness. Note that U-3 and U-4 have been subjected to this condition in excess of a year, and a hardness of 61 is still retained. It should also be noted that when these polyether polyurethanes went to a zero hardness, they still did not flow as U-1 would under similar conditions. Figure 11 shows compound U-4 after 230 days at 200°F and 100% R.H.

Compounds U-7, U-8, U-9, and U-10 (Tables VII, VIII, IX, and X, respectively) are also polyether polyurethanes. U-7 is the only polyether polyurethane evaluated that actually flowed. Figure 12 shows U-7 after 22 days at 200°F and 100% R.H. U-7 lost 50% in hardness after 120 days at 160°F.

Compound U-11 (Table XI) was described as an ester-ether hybrid. It withstood the 160°F aging well but was not as good as the qualified MIL-M-24041 materials at 200°F. Some flowing of the material did occur.

Compound U-12 (Table XII) was not identified as either an ether or an ester. It withstood the humidity much better than any other polyurethane evaluated. No other urethane came close to the performance of this material at 200°F and 100% R.H. There is some doubt that this material will perform in dry heat as well as MIL-M-24041 materials. This is being checked.

Compound U-13 (Table XIII) is a castor oil polyurethane. This material performed quite well at 160°F, actually becoming harder rather than softer. The material flowed at 200°F.

Compound U-14, U-15 and U-16 (Tables XIV, XV, and XVI, respectively) were various polyurethanes submitted for evaluation. Their exact type was unknown. Of these, U-14 performed rather well.

Compound U-17, (Table XVII) is a polyurethane proposed for use as an aircraft skin lap joint sealant. This material reverted rather quickly at 200°F but performed fairly well at 160°F.

Compounds U-18, U-19, and U-20 (Tables XVIII, XIX and XX, respectively) are polyurethane coating materials qualified to MIL-I-46058, Type PUR. All three deteriorated at 200°F. Compounds U-18 and U-19 turned dark, blistered, and chipped off whereas U-20 liquified and flowed. All failed in the 60-80-day time range. Performance at 160°F was satisfactory. Compound U-21 (Table XXI) is another coating material which is being used in an Air Force system. This material performed approximately the same as the other coatings except for a small spot which flowed at 200°F.

Compound U-22 through U-26 (Tables XXII through XXVI) are polyester polyurethane foams that are being used in Air Force systems. All deteriorated badly at 200°F but performed well at 160°F. Figure 13 shows U-23 in the original condition and after aging 71 days at 200°F and 100% R.H.

Compound U-27 is a polyester polyurethane tubing being used in an Air Force system. This material did not liquefy but crumbled badly after a relatively short exposure to humidity. Figure 14 shows the condition of the tubing after 43 days at 160°F and 100% R.H. The personnel responsible for the Air Force system which uses this tubing have been notified.

B. POLYMER B

Two formulations, B-1 and B-2 were evaluated (Tables XXVIII and XXIX). The B-1 material reverted in 15 days at 200°F and in 79 days at 160°F. This material was used extensively for potting in the F-4 subsequent to the use of polyester based polyurethanes. This material could outlast the life of an aircraft if the environmental conditions in actual operations were not too severe. The biggest problem with this material on F-4 aircraft is, however, that a very large amount of it was improperly mixed. If not properly prepared the material would be subject to early reversion. Figure 15 shows B-1 after 93 days at 160°F and 100% R.H.

Compound B-2 is another material from the same manufacturer which is used in another Air Force system for faying surface sealing, cabin pressurization, and as an aerodynamic smoother. All batches that were tested did revert. Figure 16 shows B-2 after 15 days at 200°F and 100% R.H. The personnel responsible for the aircraft system that uses this material have been informed.

C. EPOXIES

Compounds E-1 through E-7 are qualified to MIL-I-16923E. As can be seen in Tables XXX through XXXVI there is considerable difference between materials as to their hydrolytic

stability. There was very little hardness change at 160°F but as mentioned previously, the test method used is not considered adequate.

Compound E-1 (Table XXX) withstood the exposure quite well. It should be noted, however, that this was a one part material and requires a complicated stepwise curing procedure. Compound E-2 (Table XXXI) also performed quite well.

Compound E-3 (Table XXXII) performed fairly well but the insulation resistance was reduced. This reduction was fairly rapid at 200°F but did not become significant until almost 200 days at 160°F had elapsed. The material based on these results, should be considered acceptable.

Compound E-4 (Table XXXIII) performed well at 160°F but did revert at 200°F. There is uncertainty about these materials because of the problem with not recording any appreciable hardness change at 160°F. Tests on these materials are being repeated and a Shore D durometer will be used.

Compound E-5 (Table XXXIV) reverted at 200°F and also showed a significant loss in hardness at 160°F. Also, the insulation resistance was reduced considerably at both 160° and 200°F. Figure 17 shows E-5 after aging 60 days at 200°F and 100% R.H. The outer surface of this material remained intact while the center or core reverted.

Compound E-6 (Table XXXV) performed similarly to E-4 in that there was reversion at 200°F but the material showed little hardness change at 160°F. Figure 18 shows E-6 reverted after 57 days at 200°F and 100% R.H.

Compound E-7 (Table XXXVI) is another material which reverted at 200°F but did not show much change in hardness until beyond 120 days. It is unfortunate that the test was not continued further on this material because it may have performed similarly to E-5. Cure was unknown on this material because the samples were obtained from an user and the material was already cured. Figure 19 shows E-7 after 43 days at 200°F and 100% R.H.

Compound E-8 (Table XXXVII) is a material that performed about as well at 200°F as it did at 160°F. For this material (as well as with E-5) the compression load test was a more sensitive indication of degradation than the hardness test. The insulation resistance did decline, which was also experienced with E-5.

Compounds E-9, E-10 and E-11 are all the same except for changing ratio of base compound to curing agent. Results are shown in Tables XXXVIII, XXXIX, and XL, respectively.

E-9 is referred to as rigid, E-10 as semirigid, and E-11 as flexible. E-9 maintained reasonable hardness and insulation resistance values and its final appearance was excellent. E-10 and E-11 did not change significantly in hardness but the insulation resistance of both declined significantly. This is especially true of E-11. Also swelling of both E-10 and E-11 during exposure did occur.

Compound E-12 (Table XLI) was an unfilled flexible epoxy which showed very little change in hardness even at 200°F. The insulation resistance did not decline significantly although it did not start at a very high level. There were stress lines visible in the material and the 160°F samples cracked across the top.

Compounds E-13 through E-16 are specific formulations that were evaluated. Results are given in Tables XLII through XLV. All of these withstood the high humidity quite well with Compounds U-14 and U-16 showing some loss of insulation resistance at 200°F.

Compounds E-17, E-18, and E-19 (Tables XLVI, XLVII, and XLVIII, respectively) are all epoxy/polyamides and were obtained in the cured condition from the same user source as Compound E-7. These compounds retained hardness quite well, but the insulation resistance fell to very low levels. There was also swelling of the materials, 10% for E-17 and E-18 and 20% for E-19.

Compounds E-20 and E-21 (Tables XLIX and L) are epoxy/amines received from the same user. Both compounds retained hardness quite well. Insulation resistance did decrease but not nearly as much as the epoxy/polyamides.

Compounds E-22 and E-23 (Tables LI and LII) are epoxy/polysulfieds. E-22 was submitted by the user while E-23 was obtained from the potting compound manufacturer. Both materials retained reasonable hardness and insulation resistance properties. There was some flow in the E-22 samples at 200°F but the material hardened upon cooling. E-23 did not exhibit flow but did swell about 20% at 200°F and did lose adhesion to the shell after 177 days at 160°F.

Compound E-24 was submitted by the manufacturer in potted connectors and as flat sheets. Test results are shown in Table LIII. There were insufficient samples to include an exposure of these at 77°F and 50% R.H. The material did not revert but the hardness did decrease significantly, especially at 200°F.

D. SILICONES

Compound S-1 is qualified to Grade A of MIL-S-23586A. Test results on this material are shown in Table LIV. Initially the hardness decreased at 200°F. The hardness thereafter stayed constant. Insulation resistance remained at an acceptable level.

Compound S-2 is another MIL-S-23596A Grade A material. Test results are shown in Table LV. This material showed the same initial loss of hardness at 200°F as Compound S-1, but it then regained its hardness. The most significant degradation was shrinkage and severe chalking. There was more of this degradation at 160°F than at 200°F. Figure 20 shows S-2 after 177 days at 160°F and 100% R. H. Note the pulling away from the shell. Although it cannot be seen in the photograph, the surface is severely chalked. This material did not perform as well in the insulation resistance test as did S-1.

Compounds S-3 and S-4 (Tables LVI and LVII) are qualified to MIL-S-23586A Grade B. Both these materials performed quite well under the high humidity testing at both temperatures. Compound S-4 is subject to cure inhibition on the surface when exposed to amines, sulfur, and organo-metallic materials.

Compound S-5 and S-6 (Tables LVIII and LIX) are qualified to MIL-I-81550A which covers transparent silicones. Both of these materials were uneffected by the aging except for some darkening.

Compound S-7 (Table LX) was formulated to meet MIL-S-81732(AS). This specification covers a low viscosity, high strength silicone for potting applications. Compound S-7 performed quite well in these tests showing little change in hardness and insulation resistance. Compound S-8 (Table LXI) is a very similar material to S-7 except that S-8 is higher viscosity. S-8 also performed quite well. S-7 and S-8 are subject to the same cure inhibition as is compound S-4.

Compounds S-9 through S-12 (Tables LXII through LXV) are one-part silicones formulated to meet the proposed draft of MIL-A-46106A dated 30 September 1969. The individual types and classes are shown on the respective tables. These materials were evaluated in the form of coatings approximately 1/8-inch thick on aluminum panels. Compounds S-9 and S-11 which liberate acetic acid upon curing showed softening at 200°F but were otherwise satisfactory. S-10 and S-12 which are usable in the presence of copper withstood the aging quite well with only slight loss of hardness in S-12.

Compound S-13 (Table LXVI) is a silicone that has been used extensively in Air Force systems. This material performed quite well in the humidity tests.

Compound S-14 (Table LXVII) was a silicone proposed for qualification to MIL-S-23586A Grade A. At 200°F the material initially softened similar to S-1 and S-2, but then hardened. After 120 days at 200°F the material shrunk to 2/3 of its original size. This material did lose considerable hardness at 160°F when compared to other silicones.

Compound S-15 (Table LXVIII) is a fluorosilicone. This particular material was too viscous for a potting compound but it was desirable to know about its humidity resistance. Such a material properly formulated for viscosity should be usable as a high temperature, fuel resistant potting compound. The material performed quite well.

E. POLYSULFIDES

Compound T-1 (Table LXIX) is a polysulfide qualified to MIL-S-8516C. This material withstands the humidity testing at 160°F quite well even though some shrinkage was seen. The material blistered at 200°F and 100% R.H. Figure 21 shows this material after 26 days at 200°F and 100% R.H. Note that the material has blistered severely. The sealant on the left has been cut off the top of the shell. Various conditions of cure were tried but none of them were effective in eliminating the blistering. This blistering does not occur at 200°F under dry heat. Despite the blistering at 200°F, the insulation resistance stayed at an acceptable level through 120 days.

Compounds T-2 and T-3 (Tables LXX and LXXI) are polysulfides formulated to meet MIL-S-8516 but with reduced viscosity (about 300 poises). The original insulation resistance on these materials is lower than T-1. The effect of humidity testing on T-2 and T-3 was approximately the same as on T-1. There was no indication of reversion; the 160°F samples exhibited shrinkage; the 200°F samples blistered. The hardness values shown for T-1 and T-2 at 200°F should not be considered absolute since the material was blistered.

Compounds T-4 and T-5 (Tables LXXII and LXXIII) are fuel tank sealants qualified to MIL-S-8802D. As formulated they were too viscous for potting but they were evaluated to determine reversion characteristics and thus determine their potential for use as a 250°F fuel resistant potting compound. Neither material had very high initial insulation resistance but both aged quite well.

Compound T-6 (Table LXXIV) was submitted as a potential high temperature fuel resistant potting compound. The material started flowing during the first day at 200°F. There was

also some flow at 160°F. The material was not tacky as was the case with the reverting polyurethanes. Figure 22 shows this material after 58 days at 200°F and 100% R.H.

Compound T-7 (Table LXXV) is a high temperature polysulfide fuel tank sealant and cabin pressurization sealant. It has been proposed as a substitute for a material that reverts. As can be seen the material performed quite well.

Compound T-8 (Table LXXVI) was submitted as a low viscosity potting compound. The insulation resistance was initially low and the material did not perform well at either 160° or 200°F. The 160°F samples went to a O hardness but did not flow. The 200°F samples became sticky and flowed. Figure 23 shows T-8 after 22 days at 200°F and 100% R.H.

F. MISCELLANEOUS FORMULATIONS

There were four materials which were "one of a kind." These were mostly identified during the survey of Air Force systems. Since they are only one of a kind, as far as this work is concerned, they are categorized herein as miscellaneous.

Compound M-1 (Table LXXVII) was identified as a polyester/styrene. This material shrunk and cracked during cure. Hardness remained approximately constant during aging. The insulation resistance declined at both 160°F and 200°F. The 200°F insulation resistance samples cracked and fell apart after 29 days. Figure 24 shows M-1 after 41 days at 200°F and 100% R.H.

Compound M-2 (Table LXXVIII) was a wax. This material performed quite well at 160°F. The wax became soft at 200°F but did not start to flow until after 29 days exposure. The samples did not completely flow until 78 days had elapsed. Figure 25 shows the M-2 insulation resistance sample after 55 days at 200°F and 100% R.H.

Compound M-3 (Table LXXIX) is a clear vinyl which was evaluated as a coating. Other than darkening, the samples performed very well.

Compound M-4 (Table LXXX) is a polybutadiene. This material performed well.

SECTION V

CONCLUSIONS

A. POLYURETHANES

All polyurethanes that are used by the Air Force are suspect and must be tested for resistance to humidity. All specifications for these compounds should contain a severe humidity-high temperature test. Certainly, the polyurethanes most susceptible to hydrolytic instability are polyester polyurethanes which are exemplified by Compounds U-1, U-2, and U-27. This does not mean that polyester polyurethanes cannot be use [illegible] their use must be limited. There may be applications where polyester polyurethanes because of their high strength and fuel and oil resistance are the only materials that can be used. The fire and explosion suppressant foam used in aircraft fuel tanks is a polyester polyurethane and is potentially subject to deterioration by water. When degraded by water the material crumbles (same as U-27) rather than turning to a liquid. The foam is being watched closely to make certain there is no problem in service and as yet there is no indication of a problem. Of course, there is a considerably different environment for a fuel tank foam than there is for a potting compound. Water would only be present in the sump areas and high humidity at the top of the tank. The fuel being present results in much lower temperatures of the foam.

Most polyether polyurethanes are satisfactory for use, as far as resistance to humidity is concerned. The MIL-M-24041 materials will withstand very long term humidity aging at 160°F. There is deterioration at 200°F in high humidity. Some polyether polyurethanes, such as U-7 are questionable because there is a gradual loss of hardness at 160°F and rather rapid reversion at 200°F.

As stated in the discussion of test results, an Interim Amendment to MIL-M-24041 was issued by the Air Force which incorporated a humidity resistance test, exposure at 160°F and 100% R.H. for 120 days. After this time the material shall not exhibit tackiness, chalking, blistering, cracking or loss of adhesion. Loss of hardness shall not exceed 20% and the insulation resistance shall not be less than 1×10^9 ohms.

The MIL-I-46058 Type PUR coatings appear to be satisfactory because of excellent performance at 160°F. There should be a long term humidity test added to this specification.

B. POLYMER B

B-1 is 3 to 4 times better than U-1 for humidity resistance, however, an AFML sponsored program at Weber State College showed that approximately 8 years service life is all that can

be expected from B-1 when used in such areas as Southeast Asia and Panama. The manufacturer considers the identity of Polymer B as proprietary.

C. EPOXIES

Results on the epoxies are inconclusive. Some have been found that will revert at 200°F. The hardness testing at 160°F was inconclusive because there was so little change even though there was reversion at 200°F. Also, not all of the MIL-I-16923 qualified materials were evaluated. There could be some that are quite susceptible to deterioration by high humidity. Another evaluation of MIL-I-16923 materials is underway. These materials will be subjected to 160°F and 200°F, both at 95% R.H. for a period of 148 days. Hardness and volume resistivity will be tested. A Shore D durometer will be used. These tests will be completed in the fall of 1970 and an Air Force Interim Amendment and Interim Qualified Products List will be issued after that time. It is expected that the test requirements in the Amendment will be a maximum, allowable hardness loss of 20% and a minimum volume resistivity of $1X10^8$ ohm-cm after aging 120 days at 160°F and 95% R.H. These requirements are not firm and could be influenced by test results obtained. It may be necessary to have 2 classes of materials with different levels of humidity resistance.

D. SILICONES

Most silicones evaluated withstood the aging quite well. None of the materials reverted. Two materials, S-2 and S-14, shrunk badly and S-2 chalked badly. The Department of the Navy has issued MIL-S-0023586B(AS) which requires a minimum loss of hardness of 5 points and a minimum volume resistivity of $1X10^{10}$ ohm-cm after aging 28 days at 200°F and 95% R.H. Testing is now underway and the allowable loss of hardness will probably have to be increased or all MIL-S-23586 Grade A materials will be eliminated. The actual test conditions and test requirements are yet to be defined pending Navy test results.

E. POLYSULFIDES

MIL-S-8516 polysulfides withstood the aging at 160°F quite well. There was excessive blistering at 200°F and 1(R.H. and this could not be eliminated by employing various cure cycles. The MIL-S-8802D polysulfides showed little physical deterioration but the original insulation resistance was low. The Department of the Navy has issued MIL-S-008516D(AS) which requires a hardness change of -5, +15 and a minimum insulation resistance of 8000 megohms after aging 120 days at 160°F and 95% R.H. It appears these test conditions and requirements are adequate but final decisions are pending Navy test results.

SECTION VI

FUTURE WORK

Future work should be directed toward the following:

A. Finalizing humidity resistance tests in existing military potting compound specifications. Additional work could be spent on reducing the long term aging (120 days) by replacing the hardness test by some test such as tensile strength after a shorter exposure time. This would require further test work to establish correlation between 120 days aging and shorter period aging.

B. Preparation of a new military specification for polyurethanes with improved humidity resistance such as Compound U-12. The dry heat aging properties of this material will have to be further established.

C. A silicone potting compound completely resistant to reversion by heat in confined areas and by high humidity and which is not subject to surface cure inhibition is needed. Such a material should have high strength and have an initial mixed viscosity of not more than 300 poises. Specification MIL-S-81732(AS) generally describes such a material except for the cure inhibition problem.

D. A polysulfide potting compound usable up to 250°F dry heat is needed for future aircraft. Such a material should have a maximum mixed viscosity of 300 poises and should have as high a nonvolatile content as possible to keep shrinkage to a minimum.

APPENDIX

FIGURES 1 TO 25

AND

TABLES I TO LXXX

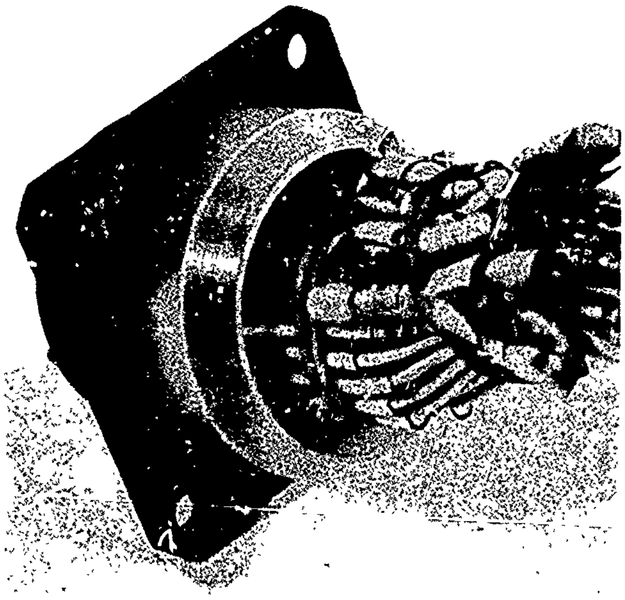

Figure 1. Connector Ready for Potting

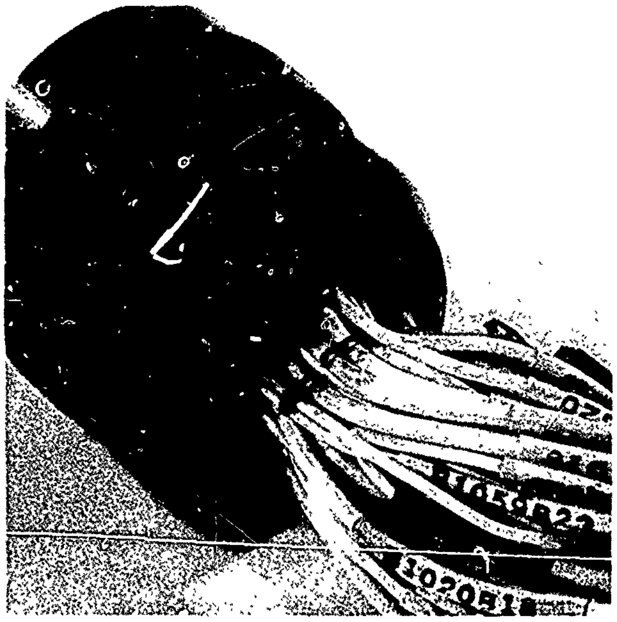

Figure 2. Potted Connector

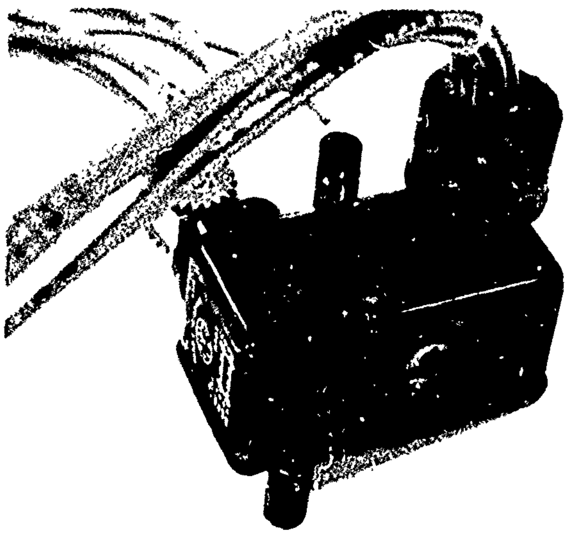

Figure 3. Switch with Potting Compound in Place

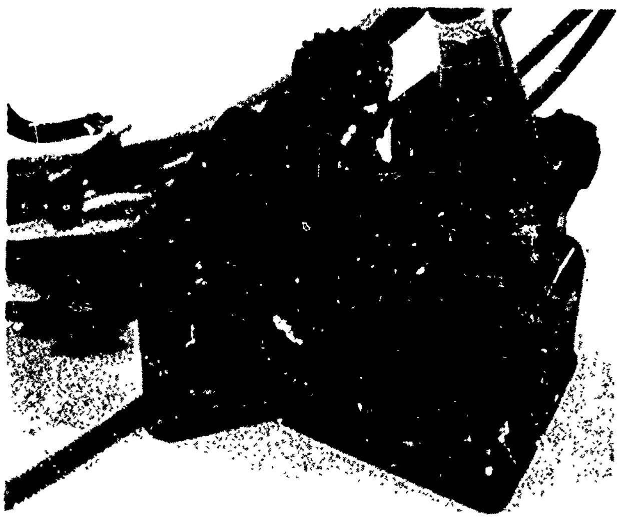

Figure 4. Switch with Potting Compound Deformed and Almost Ready to Flow

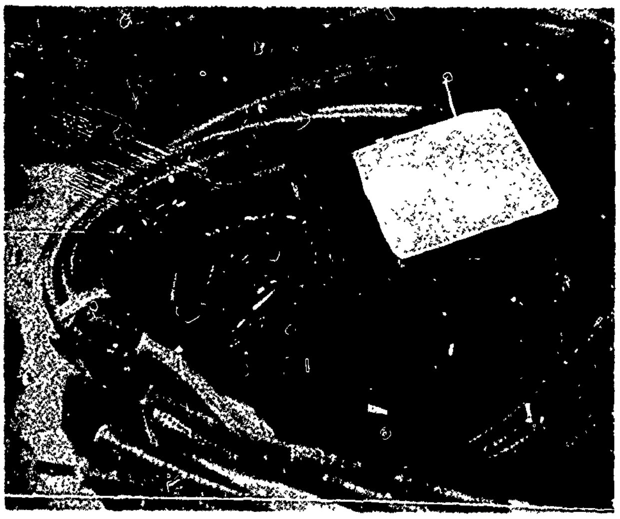

Figure 5. Relay, Potting Compound has Liquefied and Flowed

Figure 6. Relays with Reverted Potting Compound

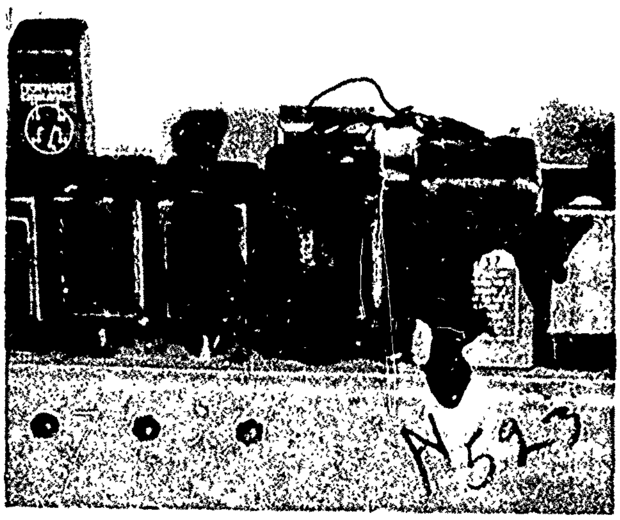

Figure 7. More Relays with Reverted Potting Compound

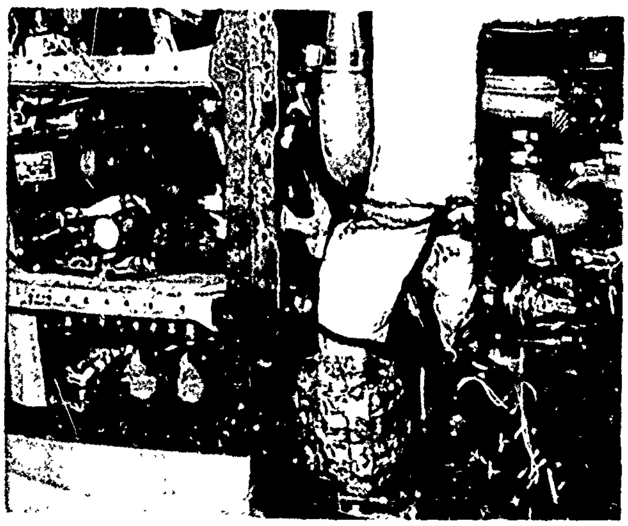

Figure 8. Potting Compound Has Reverted and Dripped Onto Duct

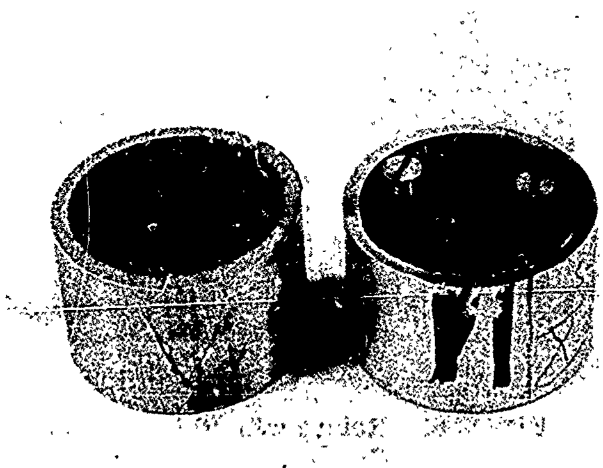

Figure 9. Specimens Ready for Humidity Testing

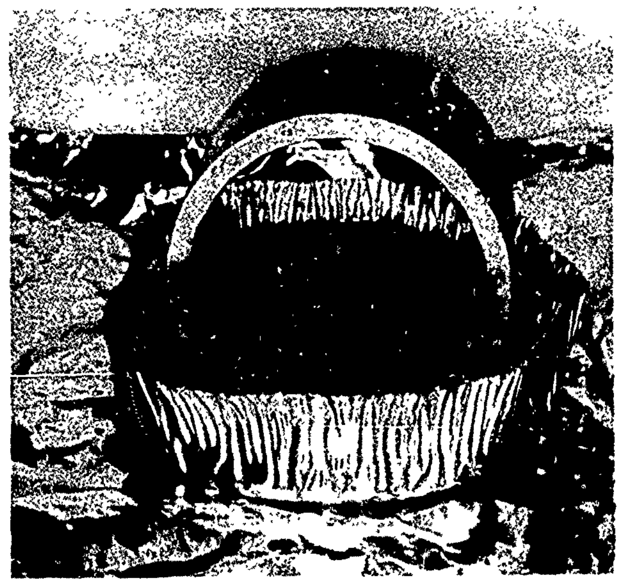

Figure 10. Compound U-2, 29 Days/160°F/ 100% R.H.

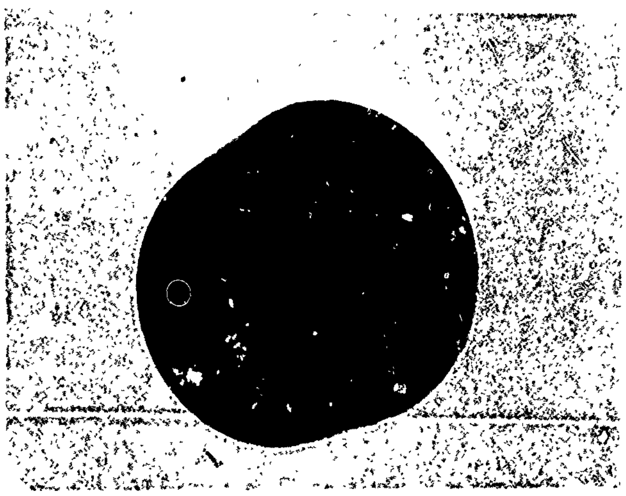

Figure 11. Compound U-4, 230 Days/200°F/ 100% R.H.

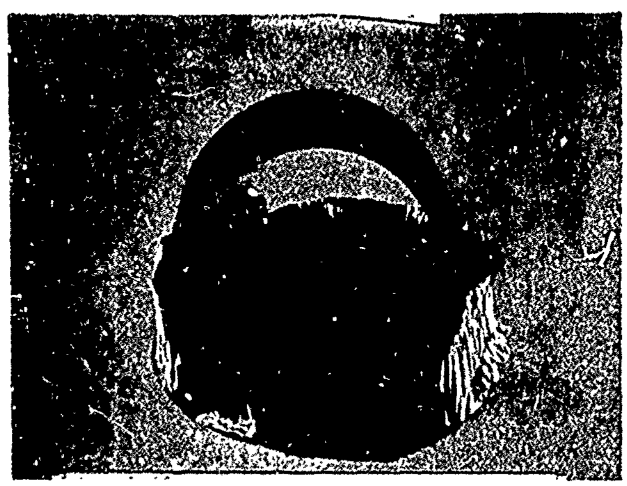

Figure 12. Compound U-7, 22 Days/200°F/ 100% R.H.

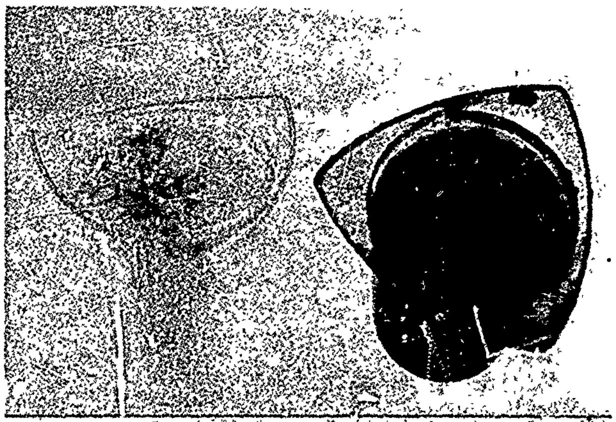

Figure 13. Original Compound U-23,71 Days/200°F/100% R. H.

Figure 14. Compound U-27,43 Days/160°F/ 100% R. H.

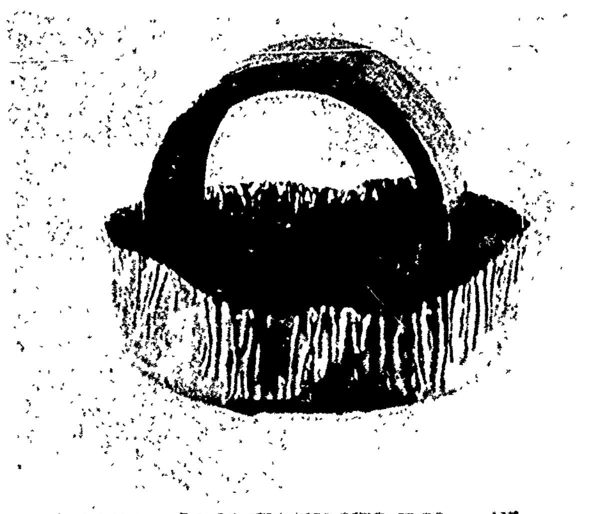

Figure 15. Compound B-1,93 Days/160°F/ 100% R. H.

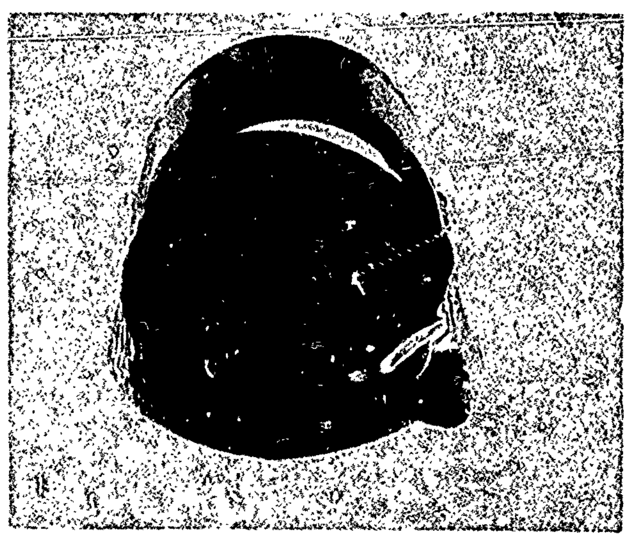

Figure 16. Compound B-2,15 Days/200°F/ 200°F/100% R. H.

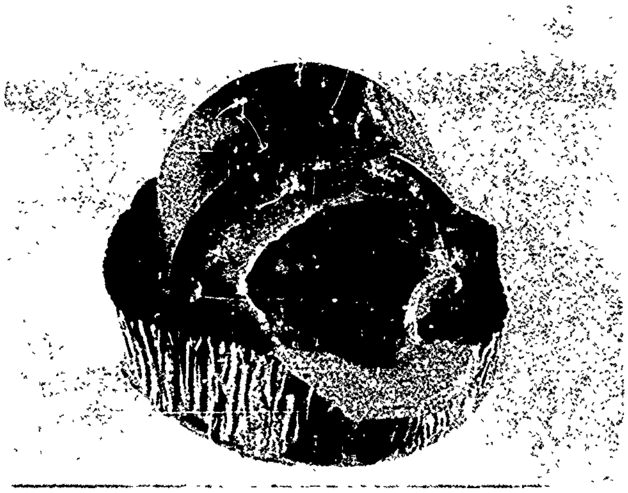

Figure 17. Compound E-5,60 Days/200°F/ 100% R.H.

Figure 18. Compound E-6,57 Days/200°F/ 100% R.H.

Figure 19. Compound E-7,43 Days/200°F/ 100% R.H.

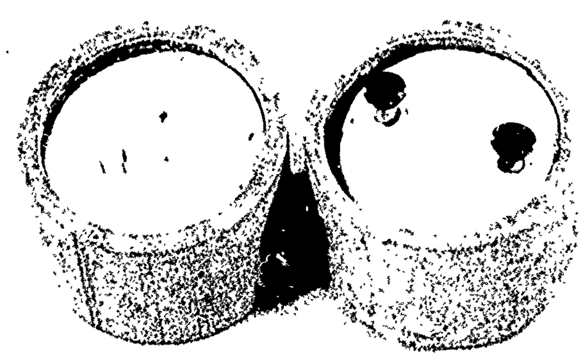

Figure 20. Compound S-2,177 Days/ 160°F/100% R.H.

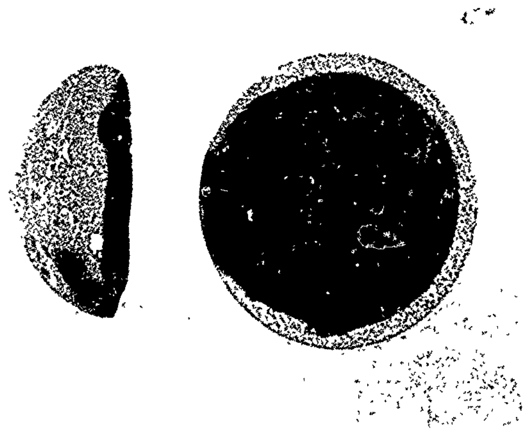

Figure 21. Compound T-1,26 Days/200°F/ 100% R. H.

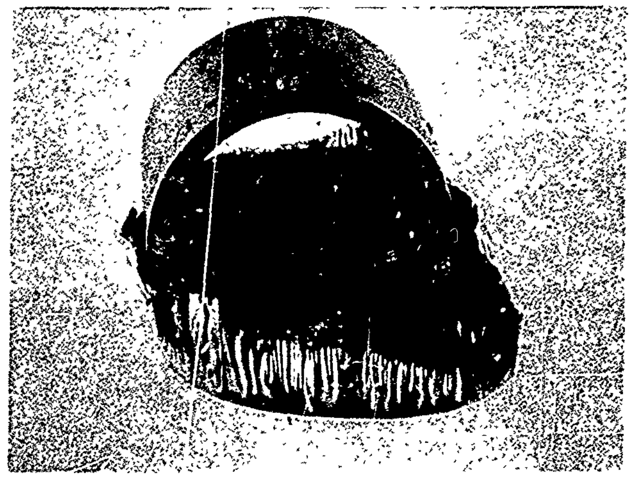

Figure 22. Compound T-6,58 Days/200°F/ 100% R. H.

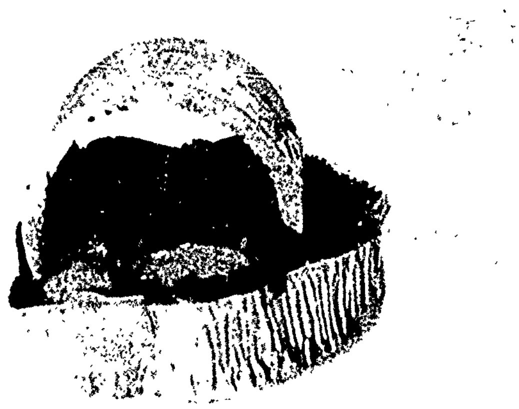

Figure 23. Compound T-8,22 Days/200°F/ 100% R. H.

Figure 24. Compound M-1,41 Days/200°F/ 100% R. H.

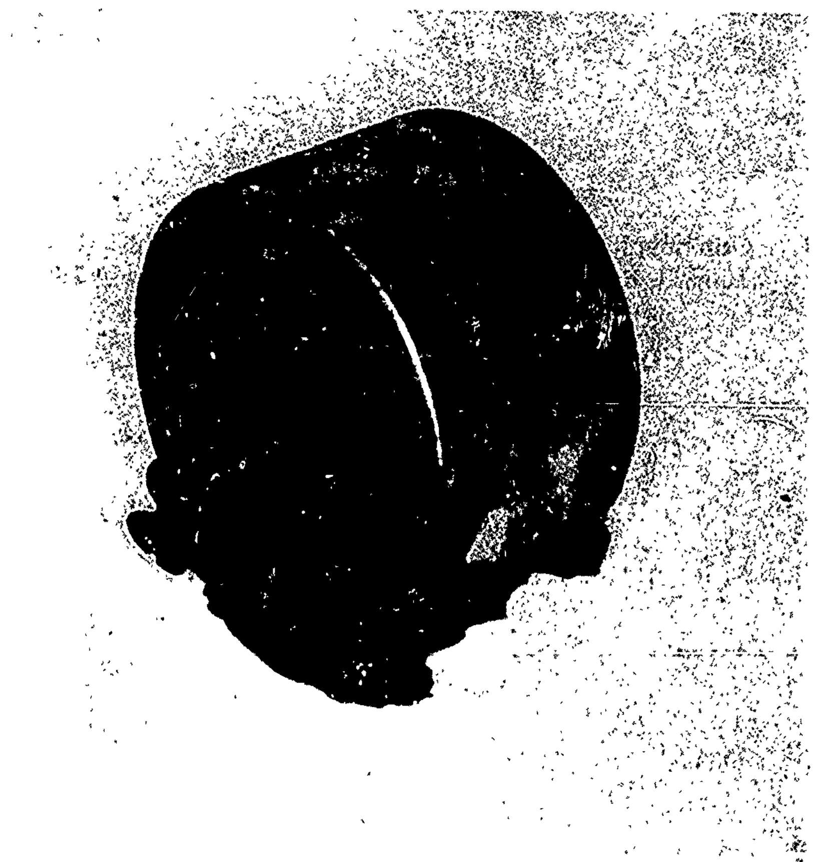

Figure 25. Compound M-2,55 Days/200DF/ 100% R.H.

TABLE I
U-1, POLYESTER POLYURETHANE
Primer Cure: 2 hours @ 77°F
Compound Cure: 48 hours @ 77°F, 3 hours @ 180°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	80.0	59	8.9×10^{10}	5[illegible].0	55	9.2×10^{10}	47.0	57	9.2×10^{10}	
2	63.0	55	—	55.0	52	—	29.0	48	—	
3	69.0	55	—	65.5	60	—	11.5	29	—	200°F samples have started losing adhesion to shell
4	62.5	55	8×10^{10}	58.5	45	1.5×10^{10}	7.0	0	5×10^{6}	
7	68.0	55	—	44.0	40	—	—	—	—	200°F samples had flowed
9	65.0	54	—	37.0	32	—	—	—	—	
11	73.0	54	5×10^{10}	38.5	36	8.7×10^{6}	—	—	—	
15	67.5	52	—	15.0	12	—	—	—	—	
18	69.0	51	4.3×10^{10}	1.5	0	5.5×10^{6}	—	—	—	
120	60.0	53	1.8×10^{9}	—	—	—	—	—	—	
205	—	55	2.5×10^{9}							77°F samples are OK, but 160°F and 200°F samples have reverted to a liquid

TABLE II
U-2, POLYESTER POLYURETHANE
Primer Cure: No Primer
Compound Cure: 168 hours @ 77^{o}F

Days Exposure	77° F /50% R.H			160° F/100% R.H.			200° F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	52	$6.6X10^9$	—	51	$4.6X10^8$	—	36	$1.1X10^8$	
8	—	52	$8.3X10^9$	—	42	$1.1X10^8$	—	—	—	200^{o}F samples have reverted
15	—	52	$6.9X10^9$	—	16	$1.1X10^8$	—	—	—	
22	—	52	$5.8X10^9$	—	—	$1X10^8$	—	—	—	160^{o}F samples soft and runny
29	—	53	$5.6X10^9$	—	—	—	—	—	—	160^{o}F samples completely flowed
85	—	51	$3.3X10^9$	—	—	—	—	—	—	
120	—	51	$3.2X10^9$	—	—	—	—	—	—	160^{o}F and 200^{o}F samples reverted

TABLE III

U-3, POLYETHER POLYURETHANE, QUALIFIED TO MIL-M-24041 INTERIM AMENDMENT 2 (USAF)
Primer Cure: 2 hours @ 77°
Compound Cure: 5 hours @ 180°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	201.0	80	$4.5X10^{11}$	236.0	83	$3.2X10^{11}$	190.5	80	$4.1X10^{11}$	
4	193.0	78	$4.4X10^{11}$	205.0	70	$1.5X10^{11}$	138.5	63	$1.1X10^{11}$	
30	220.0	71	$3.9X10^{11}$	165.0	65	$2.3X10^{11}$	35.0	46	$2.4X10^{11}$	200°F samples loose and tacky
44	230.0	78	$2.5X10^{10}$	197.0	82	$4X10^{9}$	19.5	33	$6X10^{9}$	
72	213.0	71	$2.2X10^{10}$	166.0	73	$6X10^{9}$	6.0	17	$3X10^{9}$	
120	201.0	75	$2.2X10^{10}$	121.0	75	$3X10^{9}$	–	16	$1X10^{9}$	
205	–	77	$2.5X10^{10}$	–	70	$1X10^{10}$	–	4	$2.6X10^{8}$	
261	–	88	$2.3X10^{10}$	–	67	$8X10^{9}$	–	–	$1X10^{8}$	200°F samples too low to measure for hardness
345	–	87	$1.9X10^{10}$	–	64	$6.8X10^{9}$	–	–	–	200°F samples seeping but did not flow
429	–	87	$2.1X10^{10}$	–	61	$6X10^{8}$	–	–	–	200°F samples did not flow

TABLE IV
U-4, POLYETHER POLYURETHANF, QUALIFIED TO MIL-M-24041 INTERIM AMENDMENT 2 (USAF)
Primer Cure: 1 hour @ 77°F
Compound Cure: 16 hours @ 180°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	186	81	2.6×10^{10}	[illegible]	75	1.6×10^{10}	157	70	1.1×10^{10}	
29	200	82	2.8×10^{10}	95	74	3.6×10^{9}	29	53	1.7×10^{10}	200°F samples are tacky
85	141	82	2.6×10^{10}	84	72	3.5×10^{9}	6	23	6×10^{8}	
120	136	81	2.6×10^{10}	78	69	3.1×10^{9}	4	15	4×10^{8}	
176	–	80	2.4×10^{10}	–	66	2.1×10^{9}	–	0	1.3×10^{8}	
281	–	79	2.1×10^{10}	–	61	1.7×10^{9}	–	–	1×10^{8}	200°F samples too soft for hardness determinations
365	–	80	2.3×10^{10}	–	57	1.5×10^{9}	–	–	–	
421	–	81	2.5×10^{10}	–	61	1.8×10^{9}	–	–	–	200°F samples did not flow

TABLE V

U-5, POLYETHER POLYURETHANE, FORMULATED TO MEET MIL-M-24041

Primer Cure: 1 hour @ 77°F

Compound Cure: 6 hours @ 180°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	85	$3.5X10^{10}$	—	82	$7X10^{9}$	—	80	$2.5X10^{9}$	
15	—	83	$3.1X10^{10}$	—	79	$7.1X10^{8}$	—	59	$1.4X10^{9}$	
29	—	85	$2.5X10^{10}$	—	79	$6.3X10^{8}$	—	35	$9.4X10^{8}$	
50	—	85	$2.2X10^{10}$	—	76	$6.8X10^{8}$	—	6	$4.2X10^{8}$	200°F samples are sticky
64	—	85	$1.8X10^{10}$	—	72	$7.8X10^{10}$	—	0	$4.2X10^{8}$	
120	—	84	$1.9X10^{10}$	—	68	$1.X10^{9}$	—	—	—	
197	—	82	$2X10^{10}$	—	62	$1.4X10^{9}$	—	—	—	160°F hardness samples lost adhesion to shell - 160° and 200°F insulation samples cracked

TABLE VI
U-6, POLYURETHANE CLAIMED TO MEET MIL-M-24041 BUT IS NOT ON THE QUALIFIED PRODUCTS LIST
Primer Cure: No Primer
Compound Cure: 4 hours @ 200°F

Days Exposure	77°F /50% R.H			160°F/100% R.H			200°F / 100% R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	171	84	$2.7X10^{10}$	130	76	$2.4X10^{10}$	103	72	$2.5X10^{10}$	
29	157	85	$3X10^{10}$	80	74	$2.1X10^{10}$	20	49	$6X10^{9}$	
85	154	85	$2.9X10^{10}$	53	73	$1.7X10^{10}$	8	32	$1X10^{9}$	
120	151	83	$3X10^{10}$	49	71	$1.5X10^{10}$	7	27	$6X10^{8}$	
204	—	81	$3X10^{10}$	—	65	$9X10^{9}$	—	0	$2X10^{8}$	
316	—	82	$2.7X10^{10}$	—	62	$4.5X10^{9}$	—	—	$1.4X10^{8}$	160°F and 200°F samples have pulled away from shell-200°F sample did not flow

TABLE VII
U-7, POLYETHER POLYURETHANE, BLACK
Primer Cure: No Primer
Compound Cure: 5 hours @ 180°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	55	$1.8X10^{10}$	—	54	$7.5X10^{9}$	—	48	$5.5X10^{9}$	
8	—	54	$1.7X10^{10}$	—	47	$3.8X10^{9}$	—	25	$5.8X10^{9}$	
15	—	56	$1.4X10^{10}$	—	47	$5.8X10^{9}$	—	20		200°F samples have started to flow
22	—	55	$1.4X10^{10}$	—	45	$7.9X10^{9}$	—	—		200°F samples have flowed completely out of **shells**
29	—	55	$1.7X10^{10}$	—	41	$1.1X10^{10}$	—	—		
78	—	54	$1.3X10^{10}$	—	32	$1.2X10^{10}$	—	—		
120	—	54	$1.1X10^{10}$	—	27	$9X10^{9}$	—	—		160°F samples swollen about 2%
197	—	52	$1.2X10^{10}$	—	13	$5.9X10^{9}$	—	—		
281	—	51	$9.8X10^{9}$	—	4	$3.7X10^{9}$	—	—		160°F samples obviously softened and slightly tacky, 200°F samples flowed.

TABLE VIII

U-8, POLYETHER POLYURETHANE
Primer Cure: No Primer
Compound Cure: 6½ hours @ 180°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	89	2.3×10^{10}	—	85	1.6×10^{10}	—	78	1.3×10^{10}	
15	—	87	2.3×10^{10}	—	80	6×10^{9}	—	64	1.8×10^{9}	
29	—	89	2.4×10^{10}	—	76	5×10^{9}	—	50	1.3×10^{9}	
78	—	87	2.2×10^{10}	—	70	3×10^{9}	—	31	8×10^{8}	200°F sample loose from shell
120	—	87	2.1×10^{10}	—	69	2×10^{9}	—	21	6×10^{8}	160°and 200°F samples have swollen 3-4%.
197	—	87	2×10^{10}	—	63	2.3×10^{9}	—	2	3.2×10^{8}	
225	—	86	2×10^{10}	—	63	1.8×10^{9}	—	0	2.4×10^{8}	
281	—	87	2.1×10^{10}	—	59	1.9×10^{9}	—	0	1.5×10^{8}	160°F and 200°F samples darkened considerably - 200°F samples obviously
										deteriorated - 160°F samples are OK.

TABLE IX
U-9, POLYETHER POLYURETHANE
Primer Cure: No Primer
Compound Cure: 1 hour @ 77°F, 16 hours @ 180°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	93	$3X10^{10}$	—	91	$1.6X10^{10}$	—	90	$8.2X10^{9}$	No adhesion to shell-needs primer
29	—	92	$3.2X10^{10}$	—	90	$3.4X10^{10}$	—	78	$1X10^{9}$	
78	—	92	$3.1X10^{10}$	—	90	$2.2X10^{9}$	—	47	$6X10^{8}$	
99	—	93	$3.1X10^{10}$	—	90	$2.4X10^{9}$	—	13	$3.8X10^{8}$	
120	---	93	$3.3X10^{10}$	—	91	$2.3X10^{9}$	—	3	$3.1X10^{8}$	160°F samples darkened considerably but are otherwise OK - 200°F samples are quite soft

TABLE X
U-10, POLYETHER POLYURETHANE
Primer Cure: ½ hour @ 77°F
Compound Cure: 48 hours @ 77°F, 6 hours @ 158°F

Days Exposure	77°F /50% R H Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	160°F/100% R.H. Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	200°F / 100 % R H Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Comments
1	54.0	61	$2.9X10^{10}$	51.0	55	$1.9X10^{10}$	50.0	48	$1.2X10^{10}$	160° samples loosening in shells on second day
18	56.0	65	$2.2X10^{10}$	44.0	53	$1.5X10^{10}$	11.0	15	$1.2X10^{10}$	200°F samples soft and sticky
30	51.0	60	$2.2X10^{10}$	34.0	47	$1.3X10^{10}$	4.0	11	$5X10^{9}$	
79	46.0	62	$2X10^{10}$	19.0	45	$2.5X10^{9}$	—	6	$1.4X10^{9}$	
120	45.0	65	$2X10^{10}$	17.0	43	$2.9X10^{10}$	—	5	$8X10^{8}$	
205	—	65	$2X10^{10}$	—	38	$3.8X10^{6}$	—	—	$9X10^{7}$	
345	—	65	$2X10^{10}$	—	25	$4.2X10^{8}$	—	—	—	200°F samples seeping but have not flowed
401	—	65	$2.6X10^{10}$	—	27	$8.1X10^{8}$	—	—	—	160°F samples pulled away from shell early in exposure period - 200°F never flowed

TABLE XI
U-11 POLYURETHANE, DESCRIBED AS ESTER-ETHER HYBRID
Primer Cure: No primer
Compound Cure: 24 hours @ 77°F, 16 hours @ 150°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	96	$2X10^{10}$	—	96	$3.3X10^{10}$	—	93	$2.9X10^{10}$	
29	—	98	$3.2X10^{10}$	—	91	$1.9X10^{10}$	—	80	$7.5X10^{10}$	
50	—	98	$4X10^{10}$	—	90	$1.6X10^{10}$	—	56	$5.3X10^{9}$	
71	—	98	$3.9X10^{10}$	—	85	$1.6X10^{10}$	—	27	$2.2X10^{9}$	200°F samples - insides seeping out
78	—	97	$4.3X10^{10}$	—	85	—	—	0	$7X10^{8}$	200°F samples starting to flow
120	—	98	$5.3X10^{10}$	—	87	$1.5X10^{10}$	—	—	—	
197	—	98	$6.8X10^{10}$	—	90	$1.4X10^{10}$	—	—	—	160°F samples excellent

TABLE XII
U-12, POLYURETHANE
Primer Cure: No Primer
Compound Cure: 18 hours @ 185°F

Days Exposure	77°F /50% R.H			160°F/100% R.H			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	88	$7.2X10^{10}$	—	88	$3.1X10^{11}$	—	90	$2.3X10^{11}$	
29	—	90	$2.8X10^{11}$	—	89	$2X10^{11}$	—	90	$1.6X10^{11}$	
78	—	91	$2.6X10^{11}$	—	91	$1.8X10^{11}$	—	88	$1.6X10^{11}$	
120	—	90	$4.3X10^{11}$	—	91	$2.6X10^{11}$	—	87	$2.1X10^{11}$	The 160°F and 200°F samples exhibited slight shrinkage and pulled away shell on
										one side - This is the best polyurethane we have yet evaluated for retention of
										hardness and insulation resistance while being subjected to high humidity

TABLE XIII
U-13 POLYURETHANE, CASTOR OIL
Primer Cure: No Primer
Compound Cure: 90 hours @ 77°F, 6 hours @ 180°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	94	$1X10^{10}$	—	95	$1.9X10^{10}$	—	97	$2.8X10^{10}$	
36	—	96	$1.6X10^{10}$	—	97	$2.8X10^{10}$	—	97	$2.4X10^{10}$	
67	—	97	$2.1X10^{10}$	—	98	$2.8X10^{10}$	—	50	$2.9X10^{9}$	200°F samples flow when hot
81	—	98	$2.3X10^{10}$	—	98	$4X10^{10}$	—	53		200°F samples flowed too much to measure resistance
88	—	98	$2.4X10^{10}$	—	99	$3.3X10^{10}$	—	—		200°F samples have reverted
120	—	98	$2.7X10^{10}$	—	99	$3.6X10^{10}$	—	—		160°F samples are excellent

TABLE XIV
U-14, POLYURETHANE
Primer Cure: No Primer
Compound Cure: 16 hours @ 180°F

Days Exposure	77°F /50% R H			160°F/100% R H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	92	$3X10^{10}$	—	88	$2.1X10^{10}$	—	86	$1.7X10^{10}$	
29	—	92	$3X10^{10}$	—	87	$1.5X10^{10}$	—	77	$6X10^{9}$	
78	—	91	$3X10^{10}$	—	86	$1.3X10^{10}$	—	68	$2X10^{9}$	200°F sample loose from shell
120	—	90	$2.8X10^{10}$	—	85	$1X10^{10}$	—	57	$1X10^{9}$	160°F and 200°F samples have shrunk 3%
204	—	90	$2.5X10^{10}$	—	85	$7.5X10^{9}$	—	7	$3.8X10^{8}$	
260	—	90	$2.5X10^{10}$	—	85	$6X10^{9}$	—	0	$1.9X10^{8}$	160°F and 200°F samples have pulled away from shell

TABLE XV
U-15 POLYURETHANE
Cure: Unknown

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	73	$6.9X10^9$	—	68	$6.3X10^9$	—	56	$7.5X10^9$	
29	—	73	$7.4X10^9$	—	62	$7.1X10^9$	—	42	$1X10^{10}$	
35	—	72	$7.3X10^9$	—	62	$7.1X10^9$	—	30	$8.5X10^9$	
43	—	73	$7.1X10^9$	—	63	$7.4X10^9$	—	10	—	
50	—	71	$7.2X10^9$	—	63	$7X10^9$	—	5	—	200°F samples starting to flow
85	—	64	$7X10^9$	—	53	$8X10^9$	—	—	—	200°F samples flowed
120	—	64	$7X10^9$	—	48	$8X10^9$	—	—		
148	—	63	$7X10^9$	—	34	$8X10^9$	—	—		200°F samples liquefied

TABLE XVI
U-16 POLYURETHANE
Cure: Unknown

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	90	1.8×10^{10}	—	85	5.8×10^{9}	—	87	3.2×10^{9}	
29	—	90	1.8×10^{10}	—	82	1.6×10^{9}	—	71	1.5×10^{9}	
64	—	89	1.6×10^{10}	—	80	1.6×10^{9}	—	57	1.5×10^{9}	
120	—	88	1.2×10^{10}	—	80	1.6×10^{9}	—	35	1×10^{9}	
148	—	88	—	—	78	1.9×10^{9}	—	6	7×10^{8}	200°F samples have lost adhesion to the shell, are slightly tacky and have low tear strength

TABLE XVII
U-17, POLYURETHANE AIRCRAFT SKIN LAP JOINT SEALANT
Primer Used on Aluminum Panels
Cure: Unknown

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100% R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1		69			65			61		
8		69			60			38		
15		69			57			20		
22		69			56			2		200°F samples sticky
36		67			57			—		200°F samples reverted
78		66			47			—		
120		67			45			—		Other than being softer, the 160°F samples are
										excellent

TABLE XVIII
U-18, POLYURETHANE COATING, QUALIFIED TO MIL-I-46058, TYPE PUR
Primer Cure: No Primer
Compound Cure: 8 days @ 77°F

Days Exposure	77°F /50% RH			160°F/100% RH			200°F / 100% R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										Slight chipping off on one 200°F panel
12										200°F panels are covered with small blisters
26										200°F panels are getting dark
61										160°F panels are slightly darker
80										Coating on 200°F panels chipping off
120										200°F panels are dark brown - 160°F panels are excellent

TABLE XIX
U-19, POLYURETHANE COATING, QUALIFIED TO MIL-I-46058, TYPE PUR
Primer Cure: 72 hours @ 77°F
Compound Cure: 2 coats, first coat cured 24 hours @ 77°F, Second coat applied and cured 24 hours

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										No Change
15										200°F panels starting to get large blisters
43										160°F panels slightly darker - 200°F samples getting very dark
62										200°F panels black and starting to chip off
120										No further change - 160°F panels are excellent

TABLE XX
U-20, POLYURETHANE COATING, QUALIFIED TO MIL-I-46058, TYPE PUR
Primer Cure: No Primer
Compound Cure: 16 hours @ 176°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										No change
29										200°F panels getting darker
57										200°F panels getting tacky- 160°F panels slightly darker
71										200°F panels flowed
120										No further change - 160°F panels are excellent except for being slightly darker

TABLE XXI
U-21, POLYURETHANE CONFORMAL COATING, FORMULATED TO MEET
LITTON SYSTEMS SPECIFICATION 960158-2
Primer Cure: 35 minutes @ 150°F
Compound Cure: 2 hours @ 150°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										No Change
29										200°F panel getting darker
50										200°F panel flowed in small spot in middle of panel
106										Spot did not get any bigger-200°F panel almost black
113										Tiny blisters on 200°F panels
120										No change in 160°F panel - 200°F panel flowed in one small spot after 50 days,
										turned black and slightly blistered but this was after more than 100 days

TABLE XXII
U-22, POLYESTER POLYURETHANE FOAM
Primer Cure: No Primer
Compound Cure: 1 hour @ 200°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100% R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										200°F samples slightly darker
15										200°F samples starting to shrink
27										No further change in 200°F samples - 160°F samples slightly darker
48										200°F samples continue to shrink
69										200°F samples reverted
120										No further change - except for color change, the 160°F samples are excellent

TABLE XXIII
U-23, POLYESTER POLYURETHANE FOAM
Primer Cure: No Primer
Compound Cure: 1 hour @ 225°F

Days Exposure	77°F /50% R H			160°F/100% R H			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										No change
15										200°F samples shrinking around edges
20										200°F samples have shrunk badly
27										200°F samples continue to skrink
69										200°F samples reverted
120										No further change - 160°F samples are excellent except for slight color change

TABLE XXIV
U-24, POLYESTER POLYURETHANE FOAM
Primer Cure: No Primer
Compound Cure: 3 hours @ 225°F

Days Exposure	77°F /50% R.H			160° F/100% R.H.			200° F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										200°F samples have shrunk and become dark yellow
8										160°F samples are slightly softer and darker - 200°F samples are dark brown
29										No further change
71										200°F samples are starting to shrink more
99										200°F samples are weak and crumbly
120										No further change - other than turning from a cream color to dark brown the 160°F
										samples are excellent - the 200°F samples are crumbly

TABLE XXV
U-25, POLYESTER POLYURETHANE FOAM
Primer Cure: No Primer
Compound Cure: 1 hour @ 150°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										200°F samples dark yellow
8										Bottom 3/4 of 200°F samples reverted - Top ¼ of sample did not revert
15										200°F sample very dark brown
48										160°F samples slightly brown
120										160°F samples are dark brown but otherwise OK - 77°F samples have yellowed on top

TABLE XXVI
U-26, POLYESTER POLYURETHANE FOAM
Primer Cure: No Primer
Compound Cure: 16 hours @ 185°F, 1½ hours @ 220°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										No Change
8										200°F samples are slightly darker
27										200°F samples are darker, soft when hot
34										200°F samples reverted
64										160°F samples are slightly yellow
120										No further change - except for color change the 160°F samples are excellent

TABLE XXVII
U-27, POLYESTER POLYURETHANE, ½-INCH I.D. TUBING
Cure: Unknown

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	81	—	—	72	—	—	68	—	
8	—	81	—	—	69	—	—	8	—	200°F samples crumbled when hardness was taken
29	—	80	—	—	47	—	—	—	—	
43	—	81	—	—	14	—	—	—	—	160°F samples crumbled when hardness was taken
120	—	81	—	—	—	—	—	—	—	

TABLE XXVIII
B-1, POLYMER B BASED SEALANT
Primer Cure: ½ hour @ 77°, ½ hour @ 180°F
Compound Cure: 8 hours @ 180°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	30.0	49	$2.2X10^{11}$	34.5	49	$2.2X10^{11}$	33.5	47	$2.1X10^{11}$	
4	29.5	51	$2.1X10^{11}$	35.5	51	$7.8X10^{10}$	47.0	52	$2.3X10^{11}$	
11	39.5	50	$2.6X10^{11}$	53.5	55	$6.4X10^{10}$	45.0	45	$8.3X10^{8}$	
15	25.0	53	—	54.5	56	—	—	—	—	200°F samples too bad to test. Very soft and runny.
30	35.0	53	$2.3X10^{11}$	57.0	57	$7.5X10^{9}$	—	—	—	
58	—	58	$1.1X10^{10}$	43.0	45	$5X10^{8}$	—	—	—	
65	44.0	57	$1.1X10^{10}$	17.0	28	$4X10^{8}$	—	—	—	160°F samples sticky - soft all over and runny at edges
72	33.0	56	$1.2X10^{10}$	—	8	$2X10^{8}$	—	—	—	
79	42.0	58	$1.2X10^{10}$	—	—	—	—	—	—	160°F samples running out of rings
120	50.0	63	$1.2X10^{10}$	—	—	—	—	—	—	
205	—	66	$1.4X10^{10}$	—	—	—	—	—	—	77°F samples are OK, but 160°F and 200°F samples have reverted to a liquid

TABLE XXIX
B-2 POLYMER B BASED SEALANT
Primer Cure: No Primer
Compound Cure: In excess of 14 days @ room temperature

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	63	—	—	60	—	—	58	--	
8	—	63	—	—	60	—	—	32	—	200°F samples starting to get sticky
15	—	64	—	—	58	—	—	—	—	200°F samples reverted and flowed
35	—	66	—	—	47	—	—	—	—	
43	—	67	—	—	25	—	—	—	—	
50	—	68	—	—	—	—	—	—	—	160°F samples too soft to measure
57	—	68	—	—	—	—	—	—	—	160°F samples starting to flow
64	—	68	—	—	—	—	—	—	—	160°F samples reverted and flowed
120	—	68	—	—	—	—	—	—	—	

TABLE XXX
E-1, EPOXY, ONE-PART QUALIFIED TO MIL-I-16923D, TYPE A
Primer Cure: No Primer
Compound Cure: 16 hours @ 225°F, 4 hours @ 250°F, 4 hours @ 275°F
16 hours @ 300°F, 6 hours @ 350°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	98	$4.3X10^{11}$	—	96	$1.8X10^{12}$	—	90	$3.7X10^{11}$	
29	—	98	$5.5X10^{11}$	—	96	$6.1X10^{11}$	—	89	$1.3X10^{11}$	
120	—	98	$1.4X10^{11}$	—	98	$1X10^{11}$	—	91	$2X10^{10}$	
225	—	98	$1.2X10^{11}$	—	98	$2.2X10^{11}$	—	95	$7.5X10^{9}$	Original is white, 160°F samples are tan, 200°F samples are dark brown - otherwise, samples are OK

TABLE XXXI
E-2, EPOXY, QUALIFIED TO MIL-I-16923D, TYPES B, C, AND D
Primer Cure: No Primer
Compound Cure: 16 hours @ 170°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	$6X10^{10}$	—	100	$2.8X10^{10}$	—	100	$4X10^{10}$	There was no adhesion to the shell
29	—	100	$6.9X10^{10}$	—	100	$7.3X10^{9}$	—	99	$8.1X10^{9}$	
120	—	100	$5X10^{10}$	—	100	$5X10^{9}$	—	99	$2X10^{9}$	
225	—	100	$5X10^{10}$	—	99	$6.9X10^{9}$	—	99	$2.8X10^{9}$	All samples excellent

TABLE XXXII
E-3, EPOXY, QUALIFIED TO MIL-I-16923D, TYPE B
Primer Cure: No Primer
Compound Cure: 15½ hours @ 180°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	$9.7X10^{10}$	—	100	$3.1X10^{10}$	—	100	$1.9X10^{10}$	
8	—	100	$7.9X10^{10}$	—	99	$1.1X10^{10}$	—	99	$2.3X10^{7}$	
29	—	99	$5.7X10^{10}$	—	99	$1.5X10^{9}$	—	99	$8.9X10^{7}$	
78	—	99	$4.9X10^{10}$	—	99	—	—	99	$7.5X10^{6}$	
119	—	99	$3.7X10^{10}$	—	99	$3.4X10^{9}$	—	99	$8.5X10^{5}$	
197	—	99	$3.3X10^{10}$	—	99	$1.4X10^{7}$	—	97	$6.1X10^{5}$	
253	—	99	$3.5X10^{10}$	—	98	$2.2X10^{7}$	—	98	$4.4X10^{5}$	200°F samples turned from reddish brown to black and expanded about 5% - otherwise, samples are OK.

TABLE XXXIII
E-4, EPOXY, QUALIFIED TO MIL-I-16923D, TYPES B AND C
Primer Cure: No Primer
Compound Cure: 16 hours @ 300°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100% R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	$1.8X10^{12}$	—	100	$2.8X10^{12}$	—	100	$1.4X10^{12}$	
29	—	99	$5.5X10^{12}$	—	99	$6.9X10^{11}$	—	99	$7X10^{9}$	200°F samples very soft when hot
36	—	99	$5.5X10^{12}$	—	99	$3.7X10^{11}$	—	86	$9X10^{8}$	200°F samples starting to flow
57	—	99	$5.5X10^{12}$	—	99	$1.3X10^{11}$	—	78	$5X10^{8}$	
64	—	99	$5.5X10^{12}$	—	99	$3.1X10^{10}$	—	0	$3.9X10^{8}$	200°F samples flowed too much to measure hardness
120	—	99	$5.5X10^{12}$	—	99	$1.4X10^{12}$	—	—	—	
225	—	99	$5.5X10^{12}$	—	95	$6.3X10^{10}$	—	—	—	160°F samples have turned opaque and surface is brittle - 200°F samples flowed

TABLE XXXIV
E-5, EPOXY, QUALIFIED TO MIL-I-16923D, TYPE C
Primer Cure: No Primer
Compound Cure: 16 hours @ 212°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	1655.0	90	$3.6X10^{10}$	1075.0	92	$6X10^{9}$	492.0	86	$3X10^{9}$	
3	1383.0	93	$3.8X10^{11}$	223.0	80	$4X10^{9}$	119.0	77	$5X10^{8}$	
30	1125.0	96	$3.4X10^{11}$	95.0	75	$7.1X10^{7}$	11.0	39	$1.2X10^{7}$	200°F samples sticky and chalky
37	1137.0	—	$3.6X10^{11}$	71.0	77	$6.4X10^{7}$	4.0	30	$5X10^{6}$	
44	1127.0	—	—	90.0	—	—	—	—		200°F samples burst - insides protruded out - inside softer than outer skin of material
79	1580.0	96	$\#.\#X10^{11}$	46.0	78	—	—	—		
120	1685.0	98	$3.4X10^{11}$	22.0	64	—	—	—		
205	—	97	$3.1X10^{11}$	—	37	$4.5X10^{6}$	—	—		
289	—	98	$2.7X10^{11}$	—	8	$1.4X10^{6}$		—		Both 160°F and 200°F were softened significantly

TABLE XXXV
E-6, EPOXY, QUALIFIED TO MIL-I-16923D, TYPES C AND D
Primer Cure: No Primer
Compound Cure: 20 hours @ 180°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100% R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	99	$5.2X10^{10}$	—	99	$1.9X10^{10}$	—	99	$1.5X10^{10}$	
8	—	99	$5.2X10^{10}$	—	99	$1.1X10^{10}$	—	94	$3.3X10^{8}$	200°F samples swollen about 8%
22	—	99	$4.9X10^{10}$	—	99	$5.2X10^{9}$	—	64	$2.9X10^{6}$	200°F sample - soft spot when hot, hardens upon cooling
29	—	99	$4.7X10^{10}$	—	99	$5X10^{9}$	—	54	$1.4X10^{6}$	
36	—	99	$4.7X10^{10}$	—	99	$3.9X10^{9}$	—	32	$2.1X10^{7}$	
43	—	99	$4.7X10^{10}$	—	98	$3.4X10^{9}$	—	35	$1.3X10^{8}$	
50	—	99	$4.3X10^{10}$	—	98	$3.1X10^{9}$	—	50	$1.9X10^{7}$	200°F samples starting to flow
57	—	99	$4.5X10^{10}$	—	98	$2.6X10^{9}$	—	0	—	200°F samples completely flowed
119	—	99	$2.9X10^{10}$	—	97	$1.5X10^{9}$	—	—	—	
169	—	99	$2.7X10^{10}$	—	95	$1.3X10^{8}$	—	—	—	
225	—	99	$2.7X10^{10}$	—	90	$7.8X10^{5}$	—	—	—	160°F samples swollen about 3% otherwise OK-200°F samples flowed.

TABLE XXXVI
E-7, EPOXY, QUALIFIED TO MIL-I-16923E, TYPE D
Cure: Unknown

Days Exposure	77°F /50% R.H.			160°F/100% R.H			200°F / 100 % R H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	98	$3.7X10^{10}$	—	98	$1.2X10^{10}$	—	96	$1X10^{10}$	
29	—	97	$4X10^{10}$	—	96	$3.8X10^{9}$	—	63	$4.7X10^{8}$	
36	—	99	$3.6X10^{10}$	—	97	$3.2X10^{9}$	—	37	$5.4X10^{6}$	Starting to run, very sticky when hot but hardens upon cooling
43	—	99	$3.6X10^{10}$	—	97	$2.3X10^{9}$	—	27	—	Flowed
78	—	98	$3.6X10^{10}$	—	93	$6X10^{8}$	—	—	—	
120	—	98	$2.6X10^{10}$	—	88	$2X10^{8}$	—	—	—	200°F samples liquified
148	—	98	$2.5X10^{10}$	—	60	$3.7X10^{7}$	—	—	—	

TABLE XXXVII
E-8, EPOXY
Primer Cure: No Primer
Compound Cure: 24 hours @ 77°F, 4 hours @ 140°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	1990.0	96	$2.9X10^{10}$	1643.0	96	—	1335.0	94	$1.9X10^{10}$	
11	1880.0	—	$2.7X10^{10}$	860.0	97	$4X10^{9}$	328.0	95	$7.X10^{8}$	
30	1048.0	95	$2.6X10^{10}$	191.0	85	$4X10^{8}$	123.0	84	$1.9X10^{8}$	Slight swelling in both the 160°F and 200°F samples
79	1670.0	96	$2.6X10^{10}$	149.0	93	$1.8X10^{8}$	116.0	95	$9X10^{7}$	
120.	1680.0	97	$2.7X10^{10}$	121.0	88	$1.2X10^{8}$	111.0	95	$6X10^{7}$	
205	—	96	$2.6X10^{10}$	—	76	$7.7X10^{7}$	—	91	$3.3X10^{7}$	
289	—	95	$2.1X10^{10}$	—	77	[illegible]$X10^{7}$	—	92	$1.5X10^{6}$	160°F and 200°F samples have darkened

TABLE XXXVIII
E-9, EPOXY, RIGID, MIXING RATIO 100/50
Primer Cure: No Primer
Compound Cure: 16 hours @ 77°F, 4 hours @ 144°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	$2.8X10^{11}$	—	99	$1.8X10^{11}$	—	99	$3.1X10^{10}$	
29	—	99	$2.1X10^{11}$	—	99	$8X10^{9}$	—	99	$3.9X10^{9}$	
120	—	99	$8X10^{10}$	—	99	$5X10^{9}$	—	99	$5X10^{8}$	
226	—	99	$8.9X10^{10}$	—	99	$3.2X10^{9}$	—	99	$6.2X10^{8}$	All samples excellent.

TABLE XXXIX

E-10, EPOXY, SEMIRIGID, MIXING RATIO 100/100

Primer Cure: No Primer

Compound Cure: 16 hours @ 77^oF, 4 hours @ 144^oF

Days Exposure	77°F /50% R.H.			160°F/100% R.H			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	98	$9.7X10^9$	—	85	$2.1X10^8$	—	85	$4X10^8$	
29	—	94	$8.6X10^9$	—	82	$7.2X10^6$	—	84	$1X10^7$	
50	—	92	$5.6X10^9$	—	80	$4.4X10^6$	—	77	$1.3X10^6$	
78	—	91	$5.7X10^9$	—	75	$2.8X10^6$	—	75	$7.6X10^5$	
120	—	92	$4.3X10^9$	—	75	$3.1X10^6$	—	77	$2.9X10^5$	
176	—	92	$4.3X10^9$	—	83	$1.3X10^6$	—	81	$1.7X10^5$	
232	—	93	$4.4X10^9$	—	84	$1.2X10^6$	—	85	$1.7X10^5$	160^oF and 200^oF samples have swollen about 3-5% - 200^oF samples more than 160^oF
										samples - otherwise, OK.

TABLE XL
E-11, EPOXY, FLEXIBLE, MIXING RATIO 100/150
Primer Cure: None
Compound Cure: 16 hours @ 77°F, 4 hours @ 144°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	55	3.5×10^{9}	—	55	2.5×10^{7}	—	54	5.6×10^{7}	
29	—	56	3.2×10^{9}	—	43	5.9×10^{5}	—	53	1.8×10^{5}	160°F and 200°F samples swollen about 10%.
50	—	55	2.3×10^{9}	—	41	2.1×10^{5}	—	44	1×10^{5}	200°F samples swollen 20%.
78	—	53	2.3×10^{9}	—	37	1×10^{5}	—	50	4×10^{4}	
120	—	55	1.5×10^{9}	—	45	1×10^{6}	—	60	3×10^{4}	
176	—	54	1.4×10^{9}	—	55	8.5×10^{4}	—	70	3×10^{4}	
232	—	60	1.4×10^{9}	—	63	8×10^{4}	—	73	2×10^{4}	160°F and 200°F remained slightly swollen after dry out.

TABLE XLI
E-12, EPOXY, TWO PART, UNFILLED
Primer Cure: No Primer
Compound Cure: 3 hours @ 150°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	63	$5.4X10^9$	—	63	$2.1X10^9$	—	62	$1.9X10^9$	
22	—	65	$5.1X10^8$	—	62	$4.1X10^8$	—	59	$7.1X10^8$	160°F sample cracked on top.
29	—	65	$5X10^8$	—	65	$3.1X10^8$	—	60	$2.3X10^8$	
78	—	64	$4.2X10^8$	—	62	$2.4X10^8$	—	56	$1.5X10^8$	
120	—	65	$4.2X10^9$	—	62	$2.6X10^8$	—	55	$1.1X10^8$	
141	—	64	$4.2X10^9$	—	62	$3.7X10^8$	—	54	$1.9X10^8$	
197	—	68	$4.2X10^9$	—	64	$2.7X10^8$	—	54	$5.9X10^8$	160°F and 200°F samples pulled away from shell. Crack across top of 160°F
										sample - stress lines visible in 160°F samples - 200°F samples have turned opaque
										(original was clear, straw colored) - 160°F samples darkened.

TABLE XLII
E-13, EPOXY, EPON 828/EPON U, 4/1
Primer Cure: No Primer
Compound Cure: 2 hours @ 150°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	$5X10^{11}$	—	100	$3.3X10^{11}$	—	100	$3.1X10^{11}$	
29	—	100	$6.9X10^{11}$	—	100	$1.6X10^{11}$	—	100	$1.1X10^{11}$	
120	—	100	$1.1X10^{12}$	—	99	$9X10^{10}$	—	99	$9X10^{10}$	
148	—	100	$1.4X10^{12}$	—	99	$1.3X10^{11}$	—	99	$8X10^{10}$	All samples excellent - the higher the temperature, the darker the material became.

TABLE XLIII
E-14, EPOXY, EPON 828/Versamid 140, 100/33
Primer Cure: No Primer
Compound Cure: 1½ hours @ 200°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	$1.4X10^{12}$	—	100	$5X10^{11}$	—	98	$6.9X10^{11}$	
29	—	100	$1.8X10^{12}$	—	100	$4X10^{10}$	—	100	$1.4X10^{10}$	
120	—	99	$1.8X10^{12}$	—	99	$9X10^{9}$	—	99	$1.2X10^{9}$	
148	—	99	$1.8X10^{12}$	—	99	$7X10^{9}$	—	99	$8X10^{8}$	All samples excellent - the higher the temperature, the darker the material became.

TABLE XLIV
E-15, EPOXY, EPON 828/M-PHENYLENEDIAMINE, 100/13
Primer Cure: No Primer
Compound Cure: 2 hours @ 175°F

Days Exposure	77°F /30% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	$9.2X10^{11}$	—	100	$5X10^{11}$	—	100	$6.1X10^{11}$	
29	—	100	$6.9X10^{11}$	—	100	$2.8X10^{11}$	—	100	$1.8X10^{11}$	
120	—	99	$9.2X10^{11}$	—	99	$1.8X10^{11}$	—	99	$2.1X10^{11}$	
148	—	99	$1.1X10^{12}$	—	99	$1.5X10^{11}$	—	99	$2X10^{11}$	All samples excellent - the higher the temperature, the darker the material became.

TABLE XLV
E-16, EPON 828/METHYL NADIC ANHYDRIDE/N,N-DIMETHYLBENZYLAMINE 100/90/1
Primer Cure: No Primer
Compound Cure: 4 hours @ 200°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	2.8×10^{12}	—	100	3.1×10^{11}	—	100	5×10^{11}	
29	—	100	2.8×10^{12}	—	100	3.5×10^{11}	—	100	5×10^{10}	
78	—	99	1.4×10^{12}	—	99	1×10^{11}	—	98	5.4×10^{9}	
120	—	99	2.8×10^{12}	—	99	1.6×10^{11}	—	82	3.7×10^{7}	
148	—	99	2.8×10^{12}	—	99	1.3×10^{11}	—	83	8.2×10^{6}	Surfaces of 200°F samples became irregular - appearance of starting to revert.

TABLE XLVI
E-17, EPOXY/POLYAMIDE WITH 50% INERT FILL
Cure: Unknown

Days Exposure	77°F /50% R.H			160° F/100% R.H.			200° F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1		98	3.1×10^{10}	—	95	3×10^{8}	—	95	7.4×10^{8}	
29	—	97	2.9×10^{10}	—	94	6.5×10^{6}	—	94	8.8×10^{6}	
78	—	95	2.7×10^{10}	—	94	9.4×10^{5}	—	93	2×10^{6}	
120	—	96	1.9×10^{10}	—	96	3.6×10^{5}	—	95	1.4×10^{5}	160°F and 200°F samples have swollen about 10%.
148	—	95	1.7×10^{10}	—	93	2.3×10^{5}	—	95	9×10^{4}	

TABLE XLVII
E-18, EPOXY/POLYAMIDE WITH 50% INERT FILL
Cure: Unknown

Days Exposure	77°F /50% R.H Load at 10% Compression (pounds)	77°F /50% R.H Hardness (points)	77°F /50% R.H Resistance (ohms)	160°F/100% R.H. Load at 10% Compression (pounds)	160°F/100% R.H. Hardness (points)	160°F/100% R.H. Resistance (ohms)	200°F / 100 % R.H Load at 10% Compression (pounds)	200°F / 100 % R.H Hardness (points)	200°F / 100 % R.H Resistance (ohms)	Comments
1	—	99	$1.8X10^{11}$	—	98	[illegible]	—	98	$4.6X10^{9}$	
29	—	99	$2.1X10^{11}$	—	97	$7X10^{7}$	—	97	$1.9X10^{7}$	
78	—	99	$1.6X10^{11}$	—	97	$9.7X10^{6}$	—	98	[illegible]$.5X10^{6}$	
120	—	99	$1.5X10^{11}$	—	98	$5X10^{6}$	—	96	$3.2X10^{5}$	160°F and 200°F samples have swollen about 10%.
148	—	99	$1.2X10^{11}$	—	98	$3.3X10^{6}$	—	98	$1.5X10^{5}$	

TABLE XLVIII
E-19, EPOXY/POLYAMIDE WITH 50% INERT FILL
Cure: Unknown

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100% R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	94	$1X10^{10}$	—	75	$8X10^{6}$	—	73	$2.3X10^{7}$	
29	—	95	$1X10^{10}$	—	78	$5X10^{5}$	—	75	$6.8X10^{5}$	
78	—	93	$1X10^{10}$	—	76	$8X10^{4}$	—	76	$1.6X10^{5}$	
120	—	94	$8X10^{10}$	—	72	$6X10^{4}$	—	77	$9X10^{4}$	160°F and 200°F samples have swollen 20-25%.
148	—	92	$8X10^{10}$	—	80	$4X10^{4}$	—	80	$7X10^{4}$	Samples almost returned to original size upon cooling and drying.

TABLE XLIX
E-20, EPOXY/AMINE WITH 50% INERT FILL
Cure: Unknown

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100% R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	99	$2.2X10^{11}$	—	100	$6.5X10^{10}$	—	100	3.[illegible]$X10^{10}$	
29	—	100	$2.3X10^{11}$	—	99	$2.5X10^{10}$	—	99	$9X10^{9}$	
120	—	99	$2.5X10^{11}$	—	99	$7X10^{8}$	—	99	$3X10^{9}$	200°F samples have swollen very slightly.
148	—	99	$2.1X10^{11}$	—	99	$1X10^{9}$	—	99	$1X10^{9}$	

TABLE L
E-21, EPOXY/AMINE WITH 60% INERT FILL
Cure: Unknown

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	$2.6X10^{10}$	—	99	$7.7X10^{9}$	—	99	$6.6X10^{9}$	
29	—	100	$2.6X10^{10}$	—	99	$8X10^{8}$	—	99	$6X10^{8}$	
120	—	100	$2.3X10^{10}$	—	99	$3X10^{8}$	—	99	$9.2X10^{7}$	200°F samples have swollen very slightly.
148	—	100	$2X10^{10}$	—	99	$3X10^{8}$	—	99	$6.3X10^{7}$	

TABLE LI
E-22, EPOXY/POLYSULFIDE
Cure: Unknown

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	78	$1.7X10^{10}$	—	80	$4.2X10^{9}$	—	65	$1.7X10^{9}$	
22	—	78	$1.6X10^{10}$	—	73	—	—	68	$2X10^{8}$	200°F samples starting to flow.
78	—	76	$1.6X10^{10}$	—	64	$1.8X10^{8}$	—	57	$2.1X10^{8}$	200°F samples continue to slowly flow.
120	—	80	$1.3X10^{10}$	—	70	$1.7X10^{8}$	—	58	$1.6X10^{8}$	160°F samples have swollen slightly.
148	—	80	$1.1X10^{10}$	—	70	$1.5X10^{8}$	—	48	$1.3X10^{8}$	200°F samples still flowing - hardens upon cooling.

TABLE LII
E-23, EPOXY/POLYSULFIDE
Primer Cure: No Primer
Compound Cure: 48 hours @ 77°F, 48 hours @ 160°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	61.0	58	$1.1X10^{11}$	60.0	57	$8.3X10^{10}$	48.0	55	$7.7X10^{10}$	
30	57.0	55	$2.5X10^{11}$	61.0	56	$2.5X10^{10}$	24.0	48	$1.2X10^{10}$	200°F samples swollen about 20%.
120	55.0	60	$1.5X10^{11}$	52.0	57	$5X10^{9}$	14.0	38	$7.5X10^{9}$	
177	—	61	$1.4X10^{11}$	—	56	$5.8X10^{9}$	—	26	$7X10^{8}$	160 F pulled away from shell. Slight swelling of 200°F samples.

TABLE LIII

E-24, EPOXY, CLEAR, SUBMITTED AS POTTED CONNECTORS

Cure: Unknown

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1					98			88		
29					77			53		
71					78			50		
120					75			10		200°F samples developed a brittle crust.

TABLE LIV
S-1, SILICONE, QUALIFIED TO MIL-S-23586A, GRADE A
Primer Cure: 1 hour @ 77°F
Compound Cure: 72 hours @ 77°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	53.0	46	$2.9X10^{12}$	43.0	40	$2.9X10^{12}$	25.0	23	$2.9X10^{12}$	
30	40.0	43	$2.9X10^{12}$	20.0	37	$4.5X10^{10}$	8.0	18	$7.6X10^{10}$	
120	34.0	44	$6.9X10^{11}$	15.0	40	$1.6X10^{10}$	7.0	21	$1X10^{10}$	
177	—	44	$6.9X10^{11}$	—	36	$1.2X10^{10}$	—	20	—	All samples excellent - 200°F samples changed color from white to tan

TABLE LV
S-2, SILICONE, QUALIFIED TO MIL-S-23586A, GRADE A
Primer Cure: 1 hour @ 77°F
Compound Cure: 72 hours @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	31.0	41	1.2×10^{12}	14.0	28	5.5×10^{10}	2.5	13	1.5×10^{8}	
8	32.5	36	1.2×10^{12}	23.5	34	2.8×10^{10}	15.0	20	2.6×10^{8}	
18	33.0	36	—	24.5	30	—	16.5	19	—	
22	31.0	37	2.3×10^{12}	23.5	31	1×10^{10}	14.5	20	—	
25	31.0	48	—	—	21	—	15.0	32	—	200°F samples coming loose from shell - 160°F samples starting to chalk
30	33.0	47	5.8×10^{11}	26.5	28	9×10^{8}	15.5	24	5×10^{7}	
65	27.0	38	8.3×10^{11}	25.0	38	3×10^{8}	12.0	21	1×10^{7}	
122	23.0	44	2.2×10^{11}	24.0	50	—	10.0	32	7×10^{8}	
177	—	43	—	—	51	—	—	31	—	160°F samples have shrunk away from shell and are badly chalked - 200°F samples pulled away from shell but did not chalk

TABLE LVI
S-3, SILICONE, QUALIFIED TO MIL-S-23586A, GRADE B
Primer Cure: 1 hour @ 77°F
Compound Cure: 72 hours @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	38.0	35	$5.8X10^{11}$	36.0	36	[illegible]$.4X10^{11}$	37.0	41	$7.2X10^{11}$	
25	45.5	37	$1.2X10^{12}$	38.5	34	$1.2X10^{12}$	34.5	32	$1.2X10^{12}$	
120	37.0	44	$2.3X10^{11}$	31.0	42	$3.6X10^{10}$	27.0	4[illegible]	$6.7X10^{10}$	
205	—	45	$3.7X10^{11}$	—	41	$2.9X10^{10}$	—	39	$4.3X10^{10}$	All samples excellent - 200°F samples changed color from light gray to tan

TABLE LVII

S-4, SILICONE, QUALIFIED TO MIL-S-23586A, GRADE B
Primer Cure: 1 hour @ 77°F
Compound Cure: 72 hours @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	26.0	36	7.2×10^{11}	22.5	36	5.8×10^{11}	17.5	35	5.8×10^{11}	
25	20.5	35	5.8×10	23.5	32	5.8×10^{11}	17.5	32	5.8×10^{11}	
120	16.0	38	2.3×10^{11}	16.0	39	8.8×10^{10}	16.0	36	2.9×10^{10}	
205	—	40	2.5×10^{11}	—	40	8.1×10^{10}	—	37	2.3×10^{10}	All samples excellent - 200°F samples changed color from white to tan

TABLE LVIII
S-5, SILICONE TRANSPARENT, QUALIFIED TO MIL-I-81550, TYPE II
Primer Cure: 1 hour @ 77°F
Compound Cure: 1 hour @ 77°F, 4 hours @ 150°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	43	5.5X10^{12}	—	49	5.5X10^{12}	—	47	5.[illegible]10^{12}	
29	—	43	5.5X10^{12}	—	50	5.5X10^{12}	—	49	3.7X10^{12}	
120	—	45	5.5X10^{12}	—	48	5.5X10^{12}	—	49	9.2X10^{11}	
225	—	43	5.5X10^{12}	—	49	2.8X10^{12}	—	48	1.1X10^{12}	The higher the temperature the darker the material became. 160°F samples
										still transparent - All samples excellent

TABLE LIX
S-6, SILICONE TRANSPARENT, QUALIFIED TO MIL-I-81550A, TYPE I
Primer Cure: 1 hour @ 77°F
Compound Cure: 1 hour @ 77°F, 4 hours @ 150°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100% R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	45	$5.5X10^{12}$	—	48	$2.8X10^{12}$	—	50	$2.8X10^{12}$	
29	—	48	$5.5X10^{12}$	—	49	$5.5X10^{12}$	—	50	$3.7X10^{11}$	
120	—	48	$5.5X10^{12}$	—	49	$5.5X10^{12}$	—	49	—	
225	—	44	$5.5X10^{12}$	—	49	$2.8X10^{12}$	—	45	$9.2X10^{11}$	The higher the temperature the darker the material became - 200°F samples still transparent - All samples excellent

TABLE LX
S-7, SILICONE, HIGH STRENGTH, FORMULATED TO MEET
MIL-S-81732 (USAF)
Primer Cure: 1 hour @ 77°F
Compound Cure: 9 days @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	37	$2.8X10^{12}$	—	38	$1.4X10^{12}$	—	38	$1.8X10^{12}$	
29	—	36	$2.8X10^{12}$	—	40	$3.3X10^{11}$	—	39	$2.8X10^{12}$	
120	—	48	—	—	40	$1.8X10^{12}$	—	42	$2.5X10^{11}$	
148	—	38	$5.5X10^{12}$	—	41	$1.8X10^{12}$	—	41	—	All samples excellent

TABLE LXI
S-8, SILICONE, HIGH STRENGTH
Primer Cure: 1 hour @ 77°F
Compound Cure: 6 days @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	42	5.5×10^{12}	—	42	7.9×10^{11}	—	43	9.2×10^{11}	
29	—	44	5.5×10^{12}	—	46	1.4×10^{12}	—	46	4.3×10^{11}	
119	—	43	5.5×10^{12}	—	48	2.8×10^{11}	—	49	1.8×10^{12}	
148	—	43	[illegible]$.8 \times 10^{12}$	—	—	—	—	49	1.4×10^{12}	All samples excellent

TABLE LXII
S-9, SILICONE, ONE PART, FORMULATED TO MEET PROPOSED DRAFT OF
MIL-A-46106A, Type I, Class A Dated 30 September 69
(THIXOTROPIC, ACETIC ACID LIBERATING)
Primer Cure: 1 hour @ 77°F
Compound Cure: 9 days @ 77°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	35	—	—	34	—	—	34	—	
29	—	35	—	—	31	—	—	27	—	
120	—	34	—	—	29	—	—	16	—	
148	—	31	—	—	27	—	—	13	—	200°F samples were obviously softened otherwise, samples all excellent

TABLE LXIII
S-10, SILICONE; ONE PART, FORMULATED TO MEET PROPOSED DRAFT OF
MIL-A-46106A, Type I, Class B dated 30 September 69 (THIXOTROPIC, NON-CORROSIVE)
Primer Cure: 1 hour @ 77°F
Compound Cure: 9 days @ 77°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	32	—	—	32	—	—	32	—	
29	—	34	—	—	34	—	—	33	—	
120	—	36	—	—	32	—	—	34	—	
148	—	35	—	—	32	—	—	33	—	All samples excellent

TABLE LXIV
S-11, SILICONE, ONE PART, FORMULATED TO MEET PROPOSED DRAFT OF MIL-A-46106A Type II, Class A dated 30 September 69
(Self-leveling, Acetic Acid Liberating)
Primer Cure: 1 hour @ 77°F
Compound Cure: 9 days @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	39	—	—	37	—	—	37	—	
29	—	38	—	—	35	—	—	30	—	
120	—	38	—	—	33	—	—	17	—	
148	—	38	—	—	33	—	—	16	—	200°F samples were obviously softened, otherwise, samples all excellent

TABLE LXV
S-12, SILICONE, ONE PART, FORMULATED TO MEET PROPOSED DRAFT OF
MIL-A-46106A, Type II, Class B dated 30 September 69
(Self-leveling, Non-Corrosive)
Primer Cure: 1 hour @ 77°F
Compound Cure: 9 days @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100% R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	26	—	—	26	—	—	23	—	
29	—	24	—	—	26	—	—	23	—	
120	—	29	—	—	22	—	—	21	—	
148	—	29	—	—	22	—	—	21	—	All samples excellent - 160°F and 200°F samples turned from transparent to translucent.

TABLE LXVI

S-13, SILICONE
Primer Cure: ½ hour @ $77^{o}F$
Compound Cure: 20 hours @ $77^{o}F$/60% %.R.H., 2 hours @ $100^{o}F$/95% R. H.

Days Exposure	77° F /50% R.H.			160° F/100% R.H.			200° F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	33.0	47	$2.9X10^{11}$	28.0	43	$1.2X10^{11}$	20.0	35	$7.2X10^{10}$	
30	34.0	43	$2.9X10^{11}$	26.0	41	$4.4X10^{10}$	11.0	21	$2.6X10^{10}$	
120	31.0	53	$1.6X10^{11}$	18.0	47	$2X10^{10}$	7.0	29	$1.2X10^{10}$	
177	—	51	$1.6X10^{11}$	—	43	$1X10^{10}$	—	23	$1X10^{10}$	All samples excellent

TABLE LXVII
S-14, SILICONE
Primer Cure: 1 hour @ 77°F
Compound Cure: 240 hours @ 77°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	16	32	$9X10^{9}$	13	20	$9X10^{9}$	11	22	$1X10^{10}$	
29	16	32	$1.4X10^{10}$	8	18	$.5X10^{10}$	6	15	$1.8X10^{10}$	
57	15	33	$1.6X10^{10}$	7	21	$1.3X10^{10}$	7	16	$1.5X10^{10}$	
99	—	31	$1.6X10^{10}$	—	18	$1X10^{10}$	—	21	$3X10^{5}$	
120	14	31	$1.6X10^{10}$	4	20	$9X10^{10}$	12	37	—	
204	—	30	$1.5X10^{10}$	—	20	$1.9X10^{9}$	—	52	$6X10^{5}$	The 200°F samples started to pull away from the sides of the shell at 113 days -
										At '4 days the material shrunk to 2/3 of its original size and stayed that way
										through the 204 days.

TABLE LXVIII

S-15, FLUOROSILICONE
Primer Cure: ½ hour @ 77°F
Compound Cure: 168 hours @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	23.0	30	$1X10^{10}$	32.0	35	$9.3X10^{9}$	32.0	34	$2.5X10^{10}$	
30	21.0	36	$1X10^{10}$	26.0	39	$4X10^{10}$	23.0	36	$6X10^{10}$	
120	21.0	40	$1.3X10^{10}$	24.0	41	$7.9X10^{10}$	19.0	39	$2.5X10^{10}$	
177	—	38	$1.4X10^{10}$	—	40	$1.7X10^{10}$	—	36	$1.3X10^{10}$	All samples excellent

TABLE LXIX
T-1, POLYSULFIDE, QUALIFIED TO MIL-S-8516C
Primer Cure: No Primer
Compound Cure: 48 hours @ 77°F, 48 hours @ 158°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	25.0	40	3.6×10^{11}	20.5	45	2.8×10^{11}	—	22	2.8×10^{11}	200°F samples swelled to twice original thickness - sponged - All 200°F hardness
4	29.5	45	5.8×10^{11}	26.0	51	4.4×10^{11}	—	20	5.8×10^{11}	readings questionable because of sponging
11	30.0	45	5.8×10^{11}	27.0	49	5.8×10^{11}	—	20	5.8×10^{11}	160°F samples have shrunk below initial thickness
44	26.5	52	9.6×10^{10}	28.5	62	5.4×10^{10}	—	—	—	160°F samples shrunk 10% below starting size
65	26.0	47	1.4×10^{11}	25.0	53	6×10^{10}	—	21	1.5×10^{11}	
86	23.0	47	1.4×10^{11}	20.0	46	3.4×10^{10}	—	18	4×10^{9}	
120	25.0	49	1.4×10^{11}	20.0	48	3×10^{10}	—	17	2×10^{9}	
205	—	51	1.2×10^{11}	—	45	2.7×10^{10}	—	10	9×10^{6}	77°F samples exhibit slight shrinkage, 160°F samples shrunk about 10% with some
										pulling away from shell at top and bottom. 200°F samples blistered badly.

TABLE LXX

T-2, Polysulfide, Formulated to meet MIL-S-8516 but with reduced viscosity
Primer Cure: No Primer
Compound Cure: 4 hours @ 120°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	46	$2.4X10^{10}$	—	47	$1.8X10^{10}$	—	27	$7.4X10^{10}$	200°F samples swollen to twice original size. Sponged All 200°F hardness readings,
8	—	46	$3.6X10^{10}$	—	54	$4.3X10^{10}$	—	27	$6.5X10^{10}$	questionable because of sponging 160°F samples swollen
29	—	47	$5.1X10^{10}$	—	53	$5.2X10^{10}$	—	24	$6.9X10^{10}$	approximately 20%
71	—	47	$5.9X10^{10}$	—	45	$3.3X10^{10}$	—	15	$2.2X10^{10}$	
120	—	47	$4.5X10^{10}$	—	46	$2.9X10^{10}$	—	3	$6X10^{9}$	
148	—	47	$4.3X10^{10}$	—	43	$1X10^{10}$	—	0	$6X10^{8}$	77°F samples exhibit slight shrinkage - 160°F samples shrunk about 15% with some
										pulling away from shell - 200°F samples blistered badly.

Table LXXI
T-3, Polysulfide, Formulated to meet
MIL-S-8516 but with reduced viscosity
Primer Cure: No cure
Compound Cure: 4 hours @ 120°F

Days Exposure	77°F /50% R.H			160° F/100% R.H.			200° F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	29	$1.6X10^{10}$	—	31	$6.8X10^{9}$	—	—	$1.9X10^{10}$	200°F samples swelled about 20%
8	—	30	$1.9X10^{10}$	—	35	$2.8X10^{10}$	—	—	$2.3X10^{10}$	200°F samples are spongy
29	—	32	$2.6X10^{10}$	—	42	$3.4X10^{10}$	—	—	$1.9X10^{10}$	
71	—	32	$3.8X10^{10}$	—	45	$2.8X10^{10}$	—	—	$2.5X10^{10}$	
120	—	35	$6.1X10^{10}$	—	46	$2.9X10^{9}$	—	—	$9.4X10^{9}$	200°F samples are blistered badly - 160°F samples shrunk about 10%

TABLE LXXII
T-4, Polysulfide, Qualified to MIL-S-8802D
Primer Cure: No Primer
Compound Cure: 48 hours @ 77°F, 24 hours @ 140°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	40.0	56	$6.2X10^7$	37.0	56	$4.6X10^7$	22.0	55	$7X10^7$	
30	38.0	53	$8.4X10^7$	38.0	48	$2.3X10^7$	17.0	45	$7X10^8$	
120	37.0	61	$1.5X10^9$	35.0	52	$1.9X10^8$	18.0	49	$2.9X10^8$	
177	—	60	$3.3X10^9$	—	51	$4.6X10^8$	—	40	$3X10^6$	Slight pulling away from shell in 200°F samples, also tear strength is low - otherwise samples are OK

TABLE LXXIII
T-5, POLYSULFIDE, QUALIFIED TO MIL-S-8802D
Primer Cure: No Primer
Compound Cure: 48 hours @ 77°F, 24 hours @ 140°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100% R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	48.0	53	1.5×10^9	42.0	49	1.1×10^9	37.0	48	5.5×10^8	
30	40.0	52	1.2×10^9	41.0	47	8.3×10^8	24.0	39	8×10^8	200°F samples swollen about 6% - About 2% shrinkage in 160°F samples
120	39.0	55	2×10^9	36.0	40	6×10^8	19.0	34	—	
[illegible]	—	54	1.9×10^9	—	29	4×10^8	—	33	4.3×10^5	
261	—	52	1.6×10^9	—	19	2×10^8	—	26	5×10^5	Tear strength of 160°F and 200°F is low - otherwise, OK

TABLE LXXIV

T-6, POLYSULFIDE, FOR HIGHER TEMPERATURES THAN NORMAL POLYSULFIDES
Primer Cure: No Primer
Compound Cure: 8 hours @ 180°F

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	24.0	34	6.2×10^9	20.0	32	3.8×10^9	17.0	—	5.1×10^9	Starting to run out of shells @ 200°F
3	—	36	6.2×10^9	—	31	2.5×10^9	—	27	5.4×10^9	
15	18.0	35	6.9×10^9	11.0	25	5.3×10^9	—	21	5.6×10^9	200°F samples not sticky but flowed from shell
30	17.0	35	7×10^9	8.0	28	7×10^9	—	—	—	
120	18.0	39	4×10^{10}	5.0	26	4×10^9	—	—	—	
177	—	36	4×10^{10}	—	24	3×10^8	—	—	—	200°F samples flowed from shell - slight flow evident with 160°F samples - Not tacky

TABLE LXXV
T-7, POLYSULFIDE, FOR HIGHER TEMPERATURES THAN NORMAL POLYSULFIDES
Primer Cure: No Primer
Compound Cure: 14 days @ 77^{o}F

Days Exposure	77°F /50% R.H.			160° F/100% R.H.			200° F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	50	—	—	42	—	—	33	—	
29	—	52	—	—	45	—	—	35	—	
78	—	52	—	—	44	—	—	40	—	
120	—	52	—	—	43	—	—	40	—	All samples excellent

TABLE LXXVI
T-8, POLYSULFIDE, LOW VISCOSITY
Primer Cure: No Primer
Compound Cure: 120 hours @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	38	$7.5X10^8$	—	34	$1.2X10^9$	—	43	$3.2X10^9$	200°F samples swollen about 20%
8	—	36	$1.4X10^9$	—	43	$5.3X10^7$	—	32	$1.3X10^9$	200°F samples swollen about 40%
15	—	35	$2X10^9$	—	42	$3X10^7$	—	5	$5.3X10^8$	200°F samples shrinking and sticky
22	—	36	$2.4X10^9$	—	4.	$1.5X10^8$	—	—		200°F samples flowed
29	—	33	$3X10^9$	—	41	$3.1X10^8$	—	—		
78	—	31	$4.1X10^9$	—	30	$2.5X10^8$	—	—		
120	—	32	$7X10^9$	—	17	$1.1X10^9$	—	—		
176	—	33	$7.1X10^9$	—	2	—	—	—		
197	—	33	$9.1X10^9$	—	0	$9.2X10^8$	—	—		160°F samples did not flow - Both 160°F and 200°F samples regained significant hardness upon drying out.

TABLE LXXVII
M-1, POLYESTER (70%) AND STYRENE (30%)
Primer Cure: No primer
Compound Cure: 16 hours @ 77°F, 3 hours @ 200°F
(Cracked and shrunk during cure)

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	99	$2.6X10^{11}$	—	98	$4.1X10^{10}$	—	99	$1.5X10^{9}$	
8	—	99	$3.1X10^{11}$	—	98	$9X10^{10}$	—	99	$1X10^{6}$	
29	—	99	$3.7X10^{11}$	—	97	$1.7X10^{9}$	—	93	$1.6X10^{5}$	200°F resistance sample cracked and fell apart
71	—	98	$3.7X10^{11}$	—	98	$1.1X10^{7}$	—	92	—	
120	—	97	$4.3X10^{11}$	—	97	$5.9X10^{6}$	—	95	—	Original specimens are transparent - 160°F and 200°F samples turned opaque - all samples shrunk - 200°F samples shrunk considerably

TABLE LXXVIII

M-2, WAX

Primer Cure: No Primer

Compound Cure: Wax was melted, poured into shells, and allowed to harden

Days Exposure	77°F /50% R.H			160°F/100% R.H.			200°F / 100 % R H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	85	1.4×10^{12}	—	68	4.6×10^{11}	—	—	4.6×10^{11}	No change in 160°F sample - 200°F samples are soft when hot, hardens upon cooling
29	—	85	1.4×10^{12}	—	68	5.5×10^{11}	—	—	2.2×10^{11}	200°F samples slowly flowing when hot
50	—	85	1.4×10^{12}	—	68	4.3×10^{11}	—	—	—	200°F resistance sample flowed too much to measure
78	—	85	1.4×10^{12}	—	68	4.3×10^{11}	—			All 200°F samples completely flowed
120	—	85	1.8×10^{12}	—	68	4.6×10^{11}	—			There was shrinkage of the 160°F samples but the appearance is otherwise OK

TABLE LXXIX

M-3, Vinyl, Clear, One part, Evaluated as Coating
Primer Cure: No Primer
Compound Cure: 14 days @ 77°F

Days Exposure	77°F /50% R.H.			160°F/100% R.H.			200°F / 100 % R.H			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1										No change in any samples
29										No change in 160°F samples 200°F samples slightly darker
85										160°F samples slightly darker - 200°F samples getting a little darker
120										All samples excellent - the higher the temperature, the darker the material became

TABLE LXXX

M-4 POLYBUTADIENE

RICON-150/Styrene/Supersol 101, 100/10/3
Primer Cure: No Primer
Compound Cure: 65 hours @ 250°F

Days Exposure	77°F /50% R.H			130°F/100% R.H.			200°F / 100 % R.H.			Comments
	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	Load at 10% Compression (pounds)	Hardness (points)	Resistance (ohms)	
1	—	100	—	—	100	—	—	100	—	
29	—	100	—	—	100	—	—	100	—	
120	—	99	—	—	99	—	—	99	—	
148	—	99	—	—	99	—	—	99	—	All samples excellent - the higher the temperature the darker the material became

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13. ABSTRACT

This report describes an extensive evaluation of elastomeric potting compounds for their ability to withstand long term exposure to high temperature and humidities. This work was initiated as a result of the reversion of potting compounds in the electrical connectors on the F-4 in which the compounds softened and liquefied. Materials tested include polyurethanes, epoxies, silicones and polysulfides. Coatings and tubing were tested in addition to the potting compounds. This effort involved the establishment of more severe humidity-temperature tests than were previously used in military specifications. The results of testing many specification and non-specification compounds to the more severe to the more severe conditions are included.

14 KEY WORDS	LINK A		LINK B		LINK C	
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